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DEPARTMENT OF THE ARMY TECHNICAL MANUAL
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OPERATOR, ORGANIZATIONAL
DS, GS, AND DEPOT MAINTENANCE MANUAL
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REPAIR PARTS AND SPECIAL TOOLS LISTS

MULTIPLEXER GROUP OA-7008/MRC-85(V)2
(NORTHERN RADIO TYPE 283, MODEL 1)

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HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1969
17/54

WARNING
DANGEROUS VOLTAGES
EXIST IN THIS EQUIPMENT

Be careful when working on the power supplies and their circuits, or on the 115/250-volt ac line connections.

DON'T TAKE CHANCES!

TECHNICAL MANUAL)
 NO. 11-5820-745-15)

HEADQUARTERS
 DEPARTMENT OF THE ARMY
 Washington, D. C., 7 May 1969

MULTIPLEXER GROUP OA-7008/MRC-85(V)2

Type 283 Model 1

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INTRODUCTION

This publication is the combined Service, Circuit Diagrams, and Illustrated Parts Breakdown (IPB) Technical Manual for Multiplexer Group, OA-7008/MRC-85(V)2 (Voice Frequency Telegraph Terminal, Type 283, Model 1) manufactured by Northern Radio Company of New York, New York. This equipment is a multichannel, transmitting and receiving frequency-division multiplex equipment used to provide teletypewriter or data signals over voice frequency channels.

This manual consists of seven chapters bound into one volume. Chapter 1 contains general information about the equipment. Chapter 2 contains installation information; Chapter 3 contains operating instructions; Chapter 4 contains principles of operation; Chapter 5 contains maintenance; Chapter 6 contains circuit diagrams and Chapter 7 contains the illustrated parts breakdown.

Separate technical manuals have been prepared for the plug-in subassemblies installed in the Voice Frequency Telegraph Terminal, Type 283, Model 1. Reference should be made to these manuals for a more comprehensive understanding of their operation prior to performing any maintenance routines. However, a functional discussion of the plug-in subassemblies is included in this manual.

The following is a list of the technical manuals prepared for the plug-in subassemblies contained in the Voice Frequency Telegraph Terminal, Type 283, Model 1:

- Frequency Shift Tone Keyer, Type 211, Model 1
T. O. 31W1-4-122-2
- Frequency Shift Tone Converter, Type 212, Model 2
T. O. 31W1-4-120-2
- Panel, Indicator SB-2323/MRC-85(V)2
T. O. 31W4-2MRC85-2
- Transistor Power Supply, Type 223, Model 1
T. O. 31W1-4-119-2
- Power Supply PP-4167/MRC-85(V)2 and
Control, Power Supply C-6369/MRC-85(V)2

Applicable publications governing the use of abbreviations, symbols and reference designations, used in this manual are as follows:

- MIL-T-9941 (USAF) Technical Manuals:
Ground C-E Equipment, Facility Site and System,
Preparation of
- MIL-STD-12B Abbreviations for use on Drawings and
Technical-Type Publications
- MIL-STD-15, -A1 Graphic Symbols for Electrical and
Electronic Diagrams
- MIL-STD-16C, Electrical and Electronic Reference
Designations

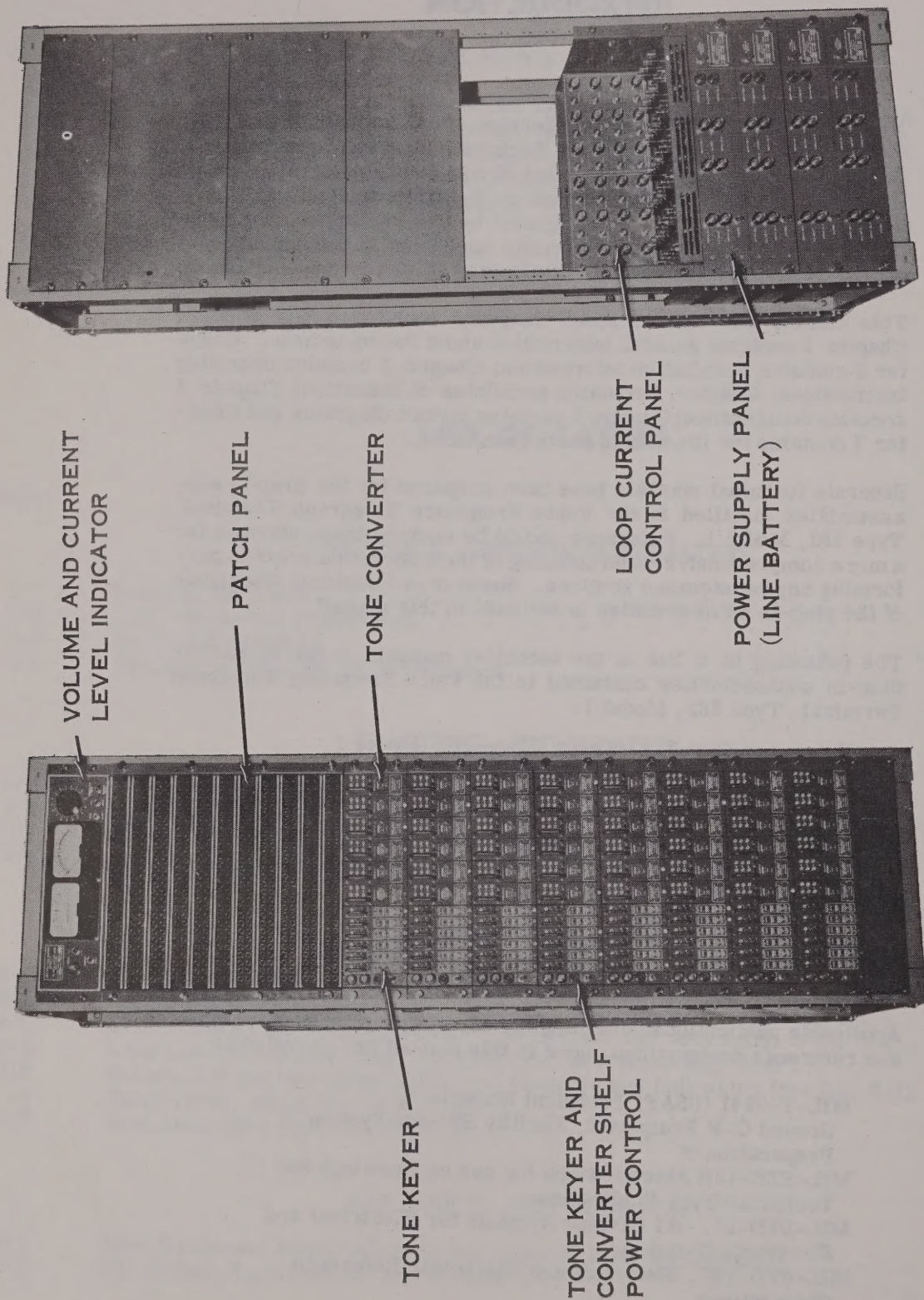


Figure 1-1. Multiplexer Group OA-7008/MRC-85(V)2

CHAPTER 1A

GENERAL

1-A.1. SCOPE

a. This manual includes installation and operation instructions and covers operator's, organizational, direct support (DS), general support (GS), and depot maintenance. It describes Multiplexer Group OA-7008/MRC-85(V)2 (Northern Radio Type 283, Model 1).

b. A basic issue items list (BIIL) for this equipment appears in appendix B; the maintenance allocation chart (MAC) appears in appendix C; the organizational repair parts appears in appendix D; and the DG, GS, and depot repair parts list appears in appendix E.

Note: Appendixes B, C, and D are current as of 13 May 1968.

1-A.2 INDEX OF PUBLICATIONS

a. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-A. 3. FORMS AND RECORDS

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army), NAVSUP Publication 378 (Navy), AFR 71-4 (Air Force), and MCO P4610-5 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38 (Army), NAVSUP Pub 459 (Navy), AFM 75-34 (Air Force), and MCO P4610.19 (Marine Corps).

d. Reporting of Equipment Manual Improvements. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-ME-NMP-AD, Fort Monmouth, N. J. 07703.

1-1. DESCRIPTION.

1-2. GENERAL.

1-3. MULTIPLEXER GROUP OA-7008/MRC-85(V)2 (Voice Frequency Telegraph Terminal, Type 283 Model 1) hereinafter referred to as VFTG group, is shown in figure 1-1.

1-4. The VFTG group consists of two standard equipment racks (RACK, ELECTRICAL EQUIPMENT MT-3325/MRC-85(V)2 and MT-3326/MRC-85(V)2) hereinafter referred to as no. 1 and no. 2 respectively. Equipment rack no. 1 contains eight frequency shift tone keyer and converter shelves, Type 239 Model 1 (MULTIPLEXER SUBASSEMBLY MC-3651/GGA-10). Each equipment shelf contains six frequency shift tone keyers, and six frequency shift tone converters. Operating power is provided to these units by two power supplies (one operational and one standby) mounted on the back of each equipment shelf. The equipment shelves also provide a load transfer relay and fuse protection for the associated power supplies. In addition, equipment rack no. 1 contains a patch panel and a volume and current level indicator.

1-5. Equipment rack no. 2 contains four power supply panels, Type 227 Model 1 (CONTROL, POWER SUPPLY C-6369/MRC-85(V)2) each of which has two line battery supplies, Type 228 Model 2 (POWER SUPPLY PP-4167/MRC-85(V)2) mounted on it. An electrical system protection panel is also provided on rack no. 2.

1-6. FREQUENCY SHIFT TONE KEYER.

1-7. The tone keyer, Type 211 Model 1 (KEYER, FREQUENCY SHIFT KY-39/GGA-10 through KY-401/GGA-10) is completely transistorized and designed for mounting in an equipment shelf. The unit is connected to power and signal lines through a receptacle on the rear of the assembly which engages a

similar receptacle on the equipment shelf. The ground return is isolated so that the tone keyers may be used in polar keying circuits.

1-8. FREQUENCY SHIFT TONE CONVERTER.

1-9. The tone converter, Type 212 Model 2 (CONVERTER, FREQUENCY SHIFT CV-1201/GGA-10, CV-1206/GGA-10 through CV-1212/GGA-10, and CV-1461/GGA-10 through CV-1464/GGA-10) is completely transistorized and designed for mounting in an equipment shelf. The unit is connected to power and signal lines through a receptacle on the rear of the assembly which engages a similar receptacle on the equipment shelf.

1-10. LOOP CURRENT CONTROL PANEL.

1-11. The loop current control panel, Type 252 Model 2 (PANEL, PROTECTION, ELECTRICAL SYSTEM SB-2328/MRC-85(V)2) is used to regulate the current in each of the 48 teleprinter loops. Current control is obtained by 48 variable resistors and 48 series limiting resistors mounted on the panel. Fuse protection for the teleprinter loops is provided by an indicator fuse mounted adjacent to each of the 48 variable resistors.

1-12. POWER SUPPLY PANEL.

1-13. The power supply panel is designed for mounting in a standard 19-inch equipment rack or on drawer type slides. Each power supply panel has the necessary controls and indicators for each of the two line battery supplies mounted on it. One line battery is operational and the other is maintained in a standby condition. The standby unit is automatically connected to the load in case of failure of the operational unit by CONTROL, POWER SUPPLY TRANSFER C-3877/GGA-10 (hereinafter referred to as load transfer relay) mounted on the power supply panel. The power supply panel and its associated line battery supplies provide the line battery voltage for the tone converters.

operation, and applying only 115 volts, the output can be reduced to 60 vdc for use in polar keying circuits. The dc output of each line battery supply is connected to alternate terminals on a load transfer switch such that, depending on the position of the switch, one power supply is maintained operative and the second is used as a standby unit. A load transfer relay is provided to automatically keep the load connected to an operative line battery supply.

1-30. TRANSISTOR POWER SUPPLY.

1-31. Two transistor power supplies, mounted on the rear of each equipment shelf, provide 12 vdc at a current of 450 ma to operate the tone keyers and tone converters. The output of each supply is connected to alternate terminals on a load transfer switch such that depending on the position of the switch, one power supply is maintained operative and the second is used as a standby unit. A load transfer relay is provided to automatically keep the load connected to the operative transistor power supply.

1-32. PATCH PANEL.

1-33. The patch panel is used to interconnect the various equipments contained in the VFTG group and connect the input and output signal lines to the tone keyers and tone converters.

The signals are routed in a predetermined manner by the normal-through configuration of the jack field. However, these assignments may be altered by patching. The patch panel is provided with monitor jacks which enable measurement of signal levels without an interruption of service.

1-34. VOLUME AND CURRENT LEVEL INDICATOR.

1-35. The volume and current level indicator is used to provide accurate and convenient signal level indications for monitoring, testing, and aligning tone telegraph equipment. Audio signal levels are indicated in volume units (1 vu is equal to 1 dbm) and dc currents are indicated in milliamperes. The unit is calibrated to measure audio signals between -60 and +29 vu at frequencies between 30 and 17,000 cycles. The dc currents are measured directly by a 75-0-75 center scale millammeter. A 7500-ohm bridging input and a 600-ohm terminating input are provided for monitoring audio signals without affecting the circuit operation.

1-36. REFERENCE INFORMATION.

1-37. The information that will help you become familiar with all of the features and characteristics of the VFTG group are listed in tables 1-1 through 1-4.

Table 1-1. Leading Particulars

Primary ac power requirement	115/250 vac $\pm 10\%$, 50/60 cycles $\pm 5\%$, single phase
Transportability:	
Air transportation	Small transport C47
Ground transportation	Heavy truck, Type M35
Physical characteristics:	
Approximate weight in pounds:	
VFTG group, rack 1	(not available at this time)
VFTG group, rack 2	(not available at this time)
Dimensions:	
VFTG group, rack 1	73-1/4 in. x 20-5/16 in. x 17-1/2 in.
VFTG group, rack 2	66-1/2 in. x 20-5/16 in. x 17-1/2 in.
Storage assembled	Upright position

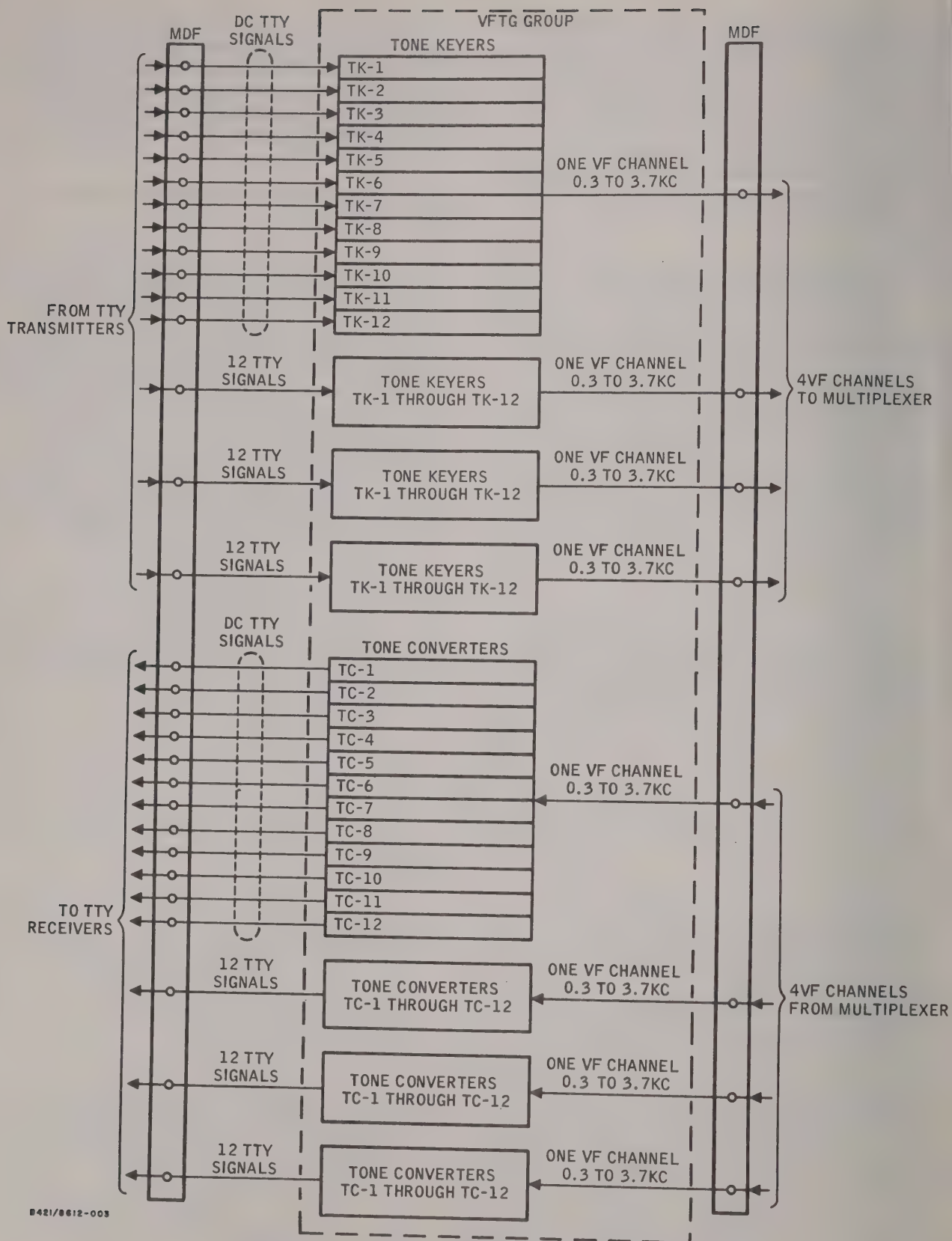


Figure 1-2. Typical Application, VFTG Group

Table 1-2. Capabilities and Limitations

Channel capacity.....	Four, 4-kc vf channels
Type of modulation.....	Frequency shift
Type of multiplexing.....	Frequency division
Keying speed	100 wpm (nominal)
Telegraph loops:	
Number	48
Type of signals.....	Neutral, polar, or contact
Teleprinter loop current	20 ma or 60 ma
Line battery voltage	60 or 120 vdc
Maximum loop resistance	2700 ohms
Impedance	
Tone keyer output	600 ohms
Tone converter input	600 ohms
Keying characteristics:	
Keying input	Contact keying; internal battery to relay contacts
	DC current pulses; positive neutral, negative neutral, or polar
	DC voltage pulses; positive neutral, negative neutral, or polar
Input level.....	DC current, high range; 15 ma minimum positive, negative or polar
	DC current, low range; 1.5 ma minimum positive, negative or polar
	DC voltage; 1 volt minimum, positive, negative or polar
Frequency allocations:	
VF channel	255 to 3655 cycles
Channel center frequencies.....	935 to 2805 cycles
Channel spacing.....	170 cycles
Frequency deviation	± 42.5 cycles
Maximum dot frequency.....	45 cycles
Processing capabilities.....	Teletype, binary digital telemetering, and control data

Table 1-2. Capabilities and Limitations

Channel capacity	Four, 4-kc vf channels
Type of modulation	Frequency shift
Type of multiplexing	Frequency division
Keying speed	100 wpm (nominal)
Telegraph loops:	
Number	48
Type of signals	Neutral, polar, or contact
Teleprinter loop current	20 ma or 60 ma
Line battery voltage	60 or 120 vdc
Maximum loop resistance	2700 ohms
Impedance	
Tone keyer output	600 ohms
Tone converter input	600 ohms
Keying characteristics:	
Keying input	Contact keying; internal battery to relay contacts
	DC current pulses; positive neutral, negative, neutral, or polar
	DC voltage pulses; positive neutral, negative, neutral, or polar
Input level	DC current, high range; 15 ma minimum positive, negative or polar
	DC current, low range; 1.5 ma minimum positive, negative or polar
	DC voltage; 1 volt minimum, positive, negative or polar
Frequency allocations:	
VF channel	255 to 3655 cycles
Channel center frequencies	935 to 2805 cycles
Channel spacing	170 cycles
Frequency deviation	± 42.5 cycles
Maximum dot frequency	45 cycles
Processing capabilities	Teletype, binary digital telemetering, and control data

CONVERTER, FREQUENCY SHIFT CV-1208/GGA-10	6-1053-8(212Z12)	Tone Converter	4	Plug-in units with appropriate frequency determining networks and polar relays for transposing frequency shifted tones to dc teletype signals
FILTER, BAND PASS F-679/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-705 692	Band Pass Filter Polar Relay	4	
CONVERTER, FREQUENCY SHIFT CV-1209/GGA-10	6-1053-9(212Z13)	Tone Converter	4	
FILTER, BAND PASS F-680/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-706 692	Band Pass Filter Polar Relay	4	
CONVERTER, FREQUENCY SHIFT CV-1210/GGA-10	6-1053-10(212Z14)	Tone Converter	4	
FILTER, BAND PASS F-681/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-707 692	Band Pass Filter Polar Relay	4	
CONVERTER, FREQUENCY SHIFT CV-1211/GGA-10	6-1053-11(212Z15)	Tone Converter	4	
FILTER, BAND PASS F-682/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-708 692	Band Pass Filter Polar Relay	4	
CONVERTER, FREQUENCY SHIFT CV-1212/GGA-10	6-1053-12(212Z16)	Tone Converter	4	
FILTER, BAND PASS F-683/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-709 692	Band Pass Filter Polar Relay	4	
KEYER, FREQUENCY SHIFT KY-390/GGA-10	6-1041-11	Tone Keyer	4	Plug-in units for transposing dc teletype signals to frequency-shifted tones
KEYER, FREQUENCY SHIFT KY-391/GGA-10	6-1041-3	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-392/GGA-10	6-1041-10	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-393/GGA-10	6-1041-4	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-394/GGA-10	6-1041-12	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-395/GGA-10	6-1041-2	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-396/GGA-10	6-1041-5	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-397/GGA-10	6-1041-9	Tone Keyer	4	

CONVERTER, FREQUENCY SHIFT CV-1208/GGA-10	6-1053-8(212Z12)	Tone Converter	4	Plug-in units with appropriate frequency determining networks and polar relays for transposing frequency shifted tones to dc teletype signals
FILTER, BAND PASS F-679/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-705 692	Band Pass Filter Polar Relay	4 4	
CONVERTER, FREQUENCY SHIFT CV-1209/GGA-10	6-1053-9(212Z13)	Tone Converter	4	
FILTER, BAND PASS F-680/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-706 692	Band Pass Filter Polar Relay	4 4	
CONVERTER, FREQUENCY SHIFT CV-1210/GGA-10	6-1053-10(212Z14)	Tone Converter	4	
FILTER, BAND PASS F-681/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-707 692	Band Pass Filter Polar Relay	4 4	
CONVERTER, FREQUENCY SHIFT CV-1211/GGA-10	6-1053-11(212Z15)	Tone Converter	4	
FILTER, BAND PASS F-682/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-708 692	Band Pass Filter Polar Relay	4 4	
CONVERTER, FREQUENCY SHIFT CV-1212/GGA-10	6-1053-12(212Z16)	Tone Converter	4	
FILTER, BAND PASS F-683/GGA-10 RELAY, POLAR RE-552/GGA-10	NRC-709 692	Band Pass Filter Polar Relay	4 4	
KEYER, FREQUENCY SHIFT KY-390/GGA-10	6-1041-11	Tone Keyer	4	Plug-in units for transposing dc teletype signals to frequency-shifted tones
KEYER, FREQUENCY SHIFT KY-391/GGA-10	6-1041-3	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-392/GGA-10	6-1041-10	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-393/GGA-10	6-1041-4	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-394/GGA-10	6-1041-12	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-395/GGA-10	6-1041-2	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-396/GGA-10	6-1041-5	Tone Keyer	4	
KEYER, FREQUENCY SHIFT KY-397/GGA-10	6-1041-9	Tone Keyer	4	

Table 1-4. Equipment Required but Not Supplied

Federal Stock Number	Description	Qty
5120-227-7334	Screwdriver, flat tip, plastic handle, 7/32 in. width	1
5120-234-8910	Screwdriver, flat tip, 5/16 in. width, 6 in. long	1
5120-180-3490	Screwdriver, flat tip, 1/4 in. width, plastic handle, 3/4 in. long	1
5120-268-3579	Pliers, long round nose, 6 in.	1
5110-222-2708	Pliers, diagonal cutting, 7-1/2 in.	1
5120-184-9382	Pliers, gas, 8 in. nominal size	1
6625-544-8691	Electronic voltmeter ME-26A/U	1
6625-724-8582	Multimeter, AN/PSM-6	1
	Test set telegraph AN/MRM-9 (TDMS)	1
6625-537-2797	Relay test adapter, P/M 14-101	1
6625-730-8513	Power supply, PP-4169/MRM-9	1
6625-446-1992	Fault locator, transmission line, TS-2146/MRM-9	1
6625-446-1993	Generator, signal SG-605/MRM-9	1
Not available	Oscilloscope (Tektronix 503)	1
6625-539-8584	Test oscillator (Hewlett-Packard 650A)	1
6625-893-0660	Frequency counter, AN/USM-26	1
MS-35297-11	Screw, cap, hex hd, 1/4-20 x 1-3/8	6
MS-35297-13	Screw, cap, hex hd, 1/4-20 x 1-3/4 lg	5
MS-35297-60	Screw, cap, hex hd, 3/8-16 x 1 lg	1
MS-35338-44	Washer, lock, split, 1/4	14
MS-35338-46	Washer, lock, split, 3/8	1
MS-15795-210	Washer, flat, 1/4	6
MS-15795-214	Washer, flat, 3/8	1
MS-35690-410	Nut, mach, hex hd, 1/4-20	16
MS-35338-25	Washer, lock, split, 1/4	16
MS-35249-88	Screw, mach, FH 1/4-20 x 3/4	14
	Rack support plate (7750573-501*)	1
	Shim resilient mount (5701035-3*)	4
	Mount resilient (7700569-1*)	2
	Nut, blind rivet, 1/4-20(7700625-1*)	1
	Mount resilient (7700569-1*)	4
	Plate (7750573-1*)	1

*Wickes Industries Part Number

CHAPTER 2 INSTALLATION

2-1. INTRODUCTION. This chapter furnishes the information you will need to install the VFTG group at an operating facility. Section I provides the data required for effective installation planning. The equipment supplied

and logistical data are listed in Section II. The procedural instructions for installation are presented in Section III. The instructions required to prepare the equipment for reshipment are presented in Section IV.

SECTION I INSTALLATION PLANNING

2-2. ENVIRONMENTAL CONSIDERATIONS.

2-3. The limiting environmental conditions for the VFTG group are as specified in table 1-2 in Chapter 1 of this manual.

2-4. AC POWER AND GROUNDING REQUIREMENTS.

2-5. The primary ac power required for the VFTG group is 115/230 vac $\pm 10\%$, 60 cycles $\pm 5\%$, single phase. The primary input may be supplied by the station power distribution system (commercial) or a diesel generator.

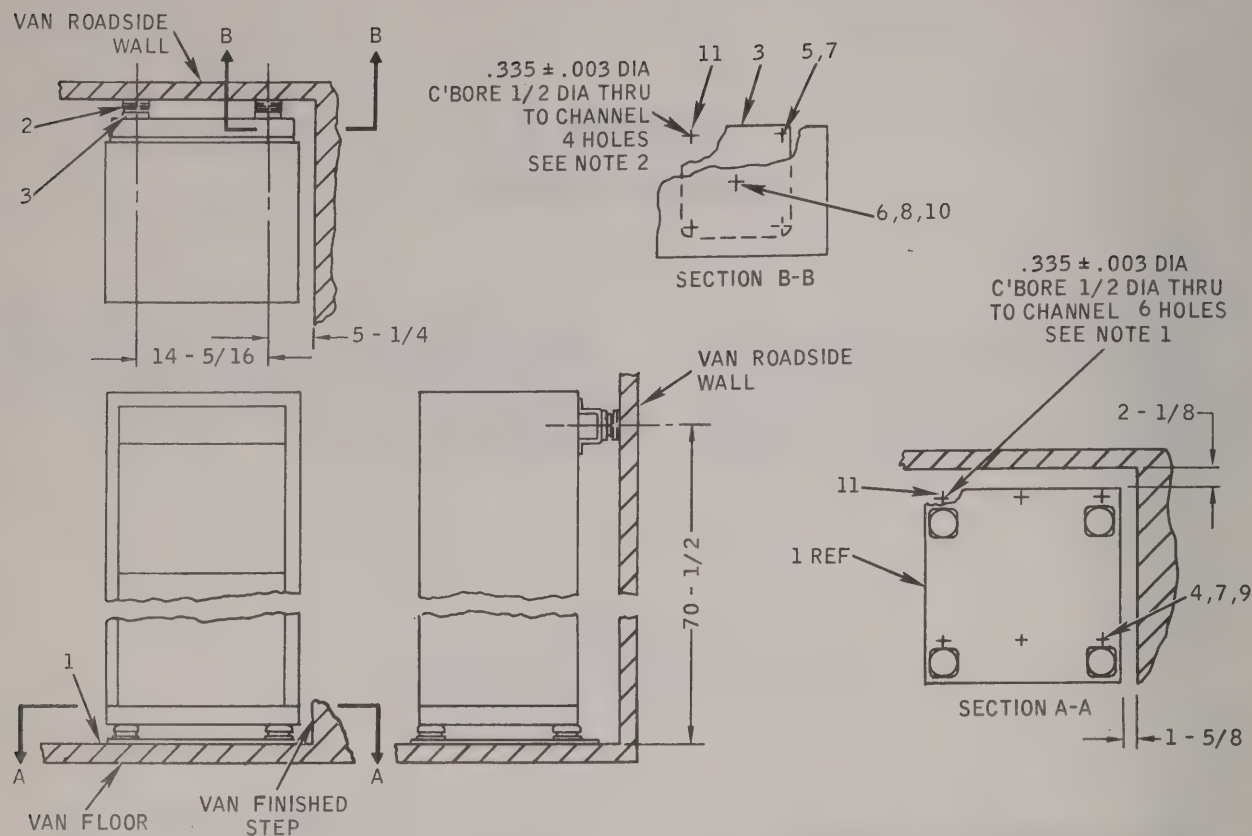
2-6. The VFTG group is grounded by means of a copper wire (AWG No. 6) that is attached from the equipment racks to the station ground.

2-7. EQUIPMENT LOCATION.

2-8. Equipment rack no. 1 requires a vertical

height of 88 inches equipment rack no. 2 requires a vertical height of 76 inches. Each rack requires a width of 21 inches, and a depth of 26 inches. In addition, a 30-inch clear aisle space at the front of each rack is needed for installation and operation of the units. The equipment racks are usually installed in the same room, van or building with its associated carrier terminal equipment.

2-9. When the equipment racks are installed in a van, they must be shock mounted as shown in figure 2-1. Special mounting hardware, such as plates, resilient mounts, and brackets are listed in table 1-4 in Chapter 1 of this manual. The plate shown in figure 2-2 must be prepared and attached to each rack prior to installing the equipment.



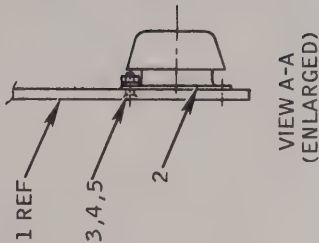
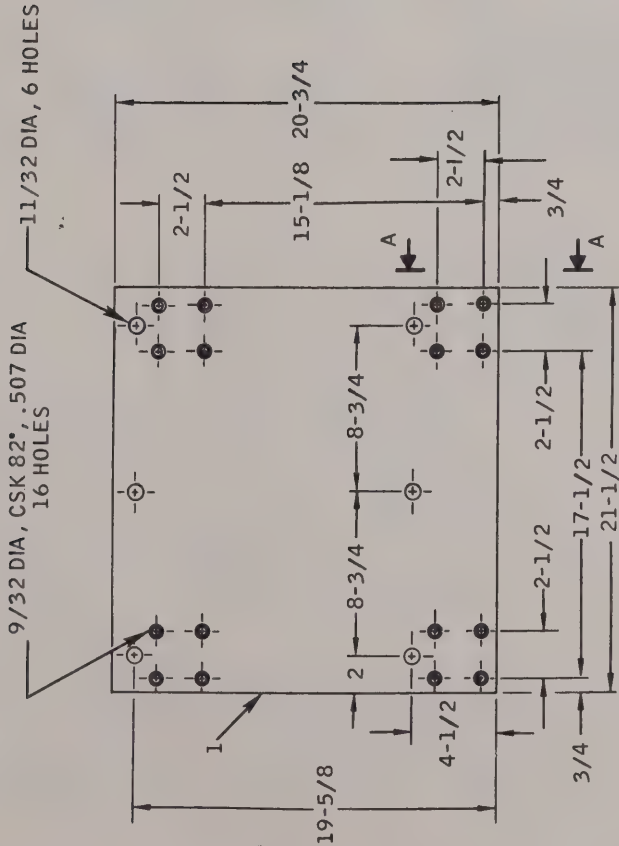
- NOTES:
- 1. TRANSFER DRILL, USING ITEM 1 AS A TEMPLATE
 - 2. TRANSFER DRILL, USING ITEM 3 AS A TEMPLATE
 - 3. ALL DIMENSIONS ARE IN INCHES

LIST OF MATERIALS			
ITEM NO.	QTY	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.
1	1	Rack Support Plate (Wickes Industries)	7750573-501
2	4	Shim, Resilient Mount (Wickes Industries)	5701035-3
3	2	Mount Resilient (Wickes Industries)	7700569-1
4	6	Screw, Cap, Hex Hd., 1/4-20 x 1-3/8 lg.	MS-35297-11
5	5	Screw, Cap, Hex Hd., 1/4-20 x 1-3/4 lg.	MS-35297-13
6	2	Screw, Cap, Hex Hd., 3/8-16 x 1 lg.	MS-35297-60
7	14	Washer, Lock, Split, 1/4	MS-35338-44
8	2	Washer, Lock, Split, 3/8	MS-35338-46
9	6	Washer, Flat, 1/4	MS-15795-210
10	1	Washer, Flat, 3/8	MS-15795-214
11	3	Nut, Blind Rivet, 1/4-20 (Wickes Industries)	7700625-1

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Figure 2-1. Installation, VFTG Equipment Racks

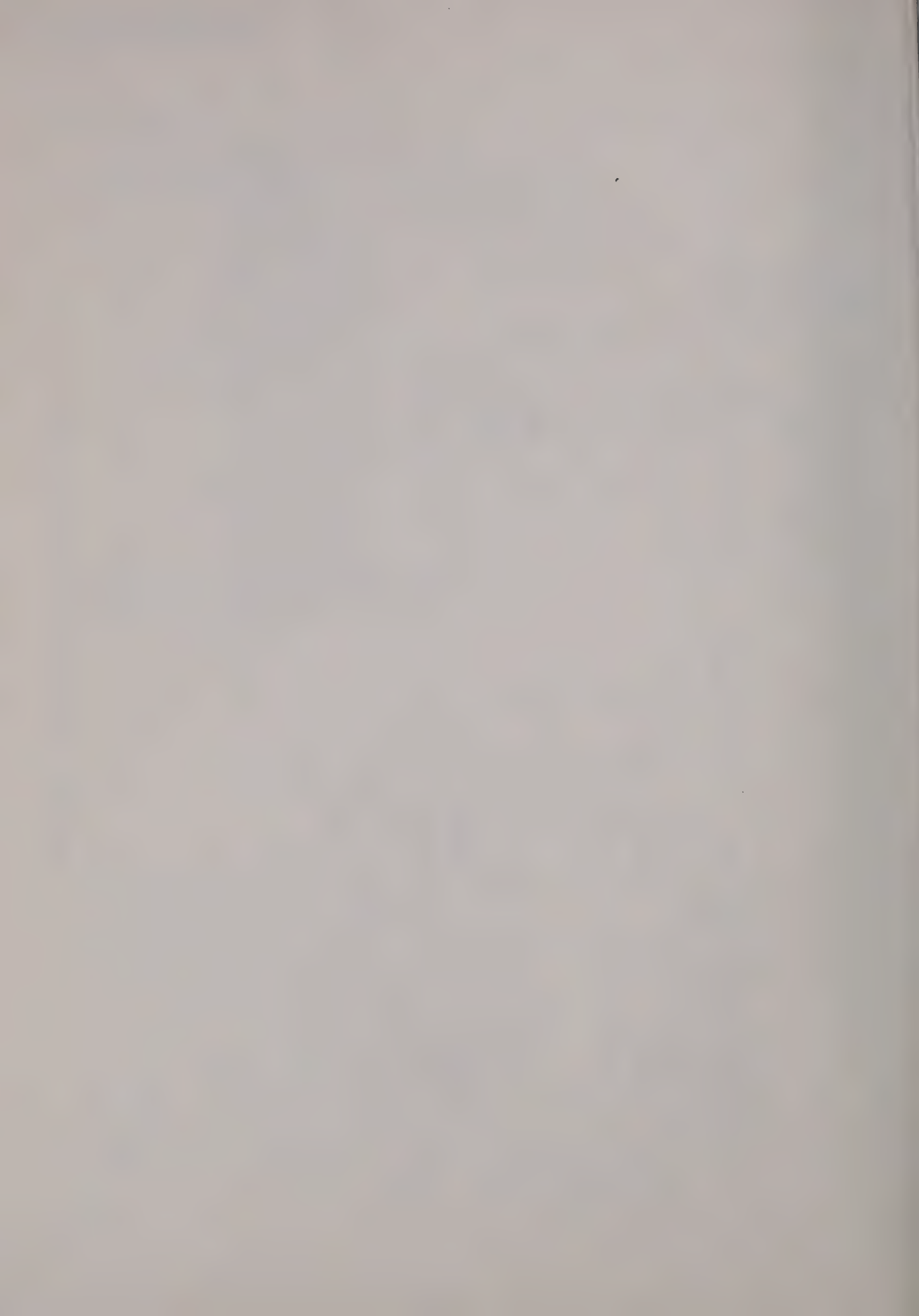
NOTE: ALL DIMENSIONS ARE EXPRESSED IN INCHES



ITEM NO.	QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
1	1	7750573-1	PLATE (Wickes Industries)
2	4	7700569-1	MOUNT, RESILIENT (Wickes Industries)
3	16	MS35249-88	SCREW, MACH, FH 1/4-20 X 3/4
4	16	MS35338-25	WASHER, LOCK, SPLIT, 1/4
5	16	MS35690-410	NUT, MACH; HEX HD, 1/4-20

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Figure 2-2. Plate Mounting, VFTG Equipment Racks



SECTION II LOGISTICS

2-10. GENERAL.

2-11. This section lists the equipment shipped which makes up the VFTG group. Packing and material-handling instructions and cable requirements, for installing the equipment, are also included.

2-12. RECEIVING DATA.

2-13. The equipments shipped to make up the VFTG group are listed in table 2-1. This table lists the following information about each crate: number, contents, weight, dimensions and volume.

2-14. TRANSPORTABILITY AND MATERIAL HANDLING.

2-15. The VFTG group may be transported to any given sight by air, rail or truck. The individual crates may be ground transported by a light truck.

2-16. When moving the small crates within the station, a conventional mover's dolly should be used. Two men are required to move the crates containing the equipment racks. However, after the equipment racks have been assembled, the equipment should not be lifted or moved unless four men or a fork lift are available.

CAUTION

Exercise extreme care when moving the equipment to avoid damage due to shock vibrations.

2-17. CABLE REQUIREMENTS.

2-18. All interconnecting cables required for installing the VFTG group are supplied with equipment and are shipped partially installed within the equipment racks. Any cable which is not partially installed, such as a power cable, is taped to the framework of the equipment rack.

Table 2-1. Equipment Shipped

Crate No.	Crate Contents	Weight (lb)	Dimensions (in.)	Volume (ft)
1.	Rack, Craig System Company, Type No. R546, including Jack Field (Patch Panel, Type 240 Model 8) and the following equipment: 8 - Keyer and Converter Shelves, Type 239 Model 1, each containing: 1 - Automatic Power Supply Control Unit, Type NRC-690 2 - Telephone Line Isolation Transformers 2 - Power Supplies, Type 223 Model 1 1 - Volume and Current Level Indicator, Type 254 Model 1		73-1/4x20-5/16x17-1/2	

Table 2-1. Equipment Shipped (cont)

Crate No.	Crate Contents	Weight (lb)	Dimensions (in.)	Volume (ft)
2	Rack, Craig System Company, Type No. R546, equipped with power wiring and slides to mount the following equipment: 1 - Manual Loop Current Control Panel, Type 252 Model 2 2 - Line Battery Power Supply Panel, Type 227 Model 1, each with: 2 - Line Battery Power Supplies, Type 228 Model 2, connected for 60 ma neutral operation 2 - Line Battery Power Supply Panels, Type 228 Model 1, each with: 2 - Line Battery Power Supplies, Type 228 Model 2, wired to provide 20 ma polar battery to the system		66-1/2x20-5/16x17-1/2	
3	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-642 through NRC-647 (211Z5 through 211Z10) 6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-698 through NRC-703 (212Z5 through 212Z10) 1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A	43	21-1/2x13-1/2x6	1.0
4	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-648 through NRC-653 (211Z11 through 211Z16) 6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-704 through NRC-709 (212Z11 through 212Z16) 1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A	43	21-1/2x13-1/2x6	1.0
5	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-642 through NRC-647 (211Z5 through 211Z10)	43	21-1/2x13-1/2x6	1.0

Table 2-1. Equipment Shipped (cont)

Crate No.	Crate Contents	Weight (lb)	Dimensions (in.)	Volume (ft)
5 (cont)	6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-698 through NRC-703 (212Z5 through 212Z10) 1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A			
6	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-684 through NRC-653 (211Z11 through 212Z16) 6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-704 through NRC-709 (212Z11 through 212Z16) 1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A	43	21-1/2x13-1/2x6	1.0
7	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-642 through NRC-647 (212Z5 through 212Z10) 6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-698 through NRC-703 (212Z5 through 212Z10) 1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A	43	21-1/2x13-1/2x6	1.0
8	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-648 through NRC-653 (211Z11 through 211Z16) 6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-704 through NRC-709 (212Z11 through 212Z16) 1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A	43	21-1/2x13-1/2x6	1.0
9	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-642 through NRC-647 (211Z5 through 211Z10)	43	21-1/2x13-1/2x6	1.0

Table 2-1. Equipment Shipped (Cont)

Crate No.	Crate Contents	Weight (lb)	Dimensions (in.)	Volume (ft)
9 (cont)	6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network; NRC-698 through NRC-703 (212Z5 through 212Z10)	43	21-1/2x13-1/2x6	1.0
	1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A			
10	6 - Frequency Shift Tone Keyers, Type 211 Model 1, each with one (1) Frequency Determining Network: NRC-648 through NRC-653 (211Z11 through 211Z16)			
	6 - Frequency Shift Tone Converters, Type 212 Model 2, each with one (1) Frequency Determining Network: NRC-704 through NRC-709 (212Z11 through 212Z16)			
	1 - Mechanical Output Relay Plug-in Assembly Type NRC-692A	43	21-1/2x13-1/2x6	1.0
11	1 Each Test Extension Adapter, NRC-750			
	1 Each Test Extension Adapter, NRC-751			
	7 Each Double Patch Cord, PJ 52 (2 ft)			
	1 Each Double Patch Cord, PJ 53 (3 ft)			
	7 Each Single Patch Cord, PJ 12 (2 ft)			
	1 Each Single Patch Cord, PJ 13 (3 ft)			

SECTION III

INSTALLATION PROCEDURES

2-19. GENERAL.

2-20. This section contains installation instructions for the VFTG group. These instructions assume that adequate space is available for locating the equipment rack. It is also assumed that mounting hardware has been procured.

2-21. The individual subassemblies comprised in the VFTG group are completely assembled before they are crated in common export type packaging. In order to expedite installation, the crates should be placed as close to the equipment rack as possible.

CAUTION

When uncrating the equipment care should be taken not to damage the packaging since the crating and insulation will be needed when reshipment is necessary.

2-22. Each piece of equipment shall be inspected for physical damage when it is unpacked. If the equipment is damaged in any way, notify the appropriate authorities.

2-23. TOOLS AND TEST EQUIPMENT.

2-24. TOOLS. The only tools required to install the VFTG group are common hand tools as listed in table 1-4.

2-25. TEST EQUIPMENT. The test equipment required to check-out and adjust the VFTG group is listed in table 1-4.

2-26. INSTALLATION OF EQUIPMENT.

2-27. GENERAL.

CAUTION

A fork lift, if available, or four men are necessary to insure safe installation of the VFTG group equipment racks.

2-28. The VFTG group is installed in the following order:

- a. Equipment shelf strapping
- b. Power supply strapping
- c. Position equipment rack no. 1
- d. Signal cabling attached to equipment rack no. 1
- e. Interconnecting and power cables attached to equipment rack no. 2
- f. Position equipment rack no. 2
- g. Install tone keyers and tone converters

2-29. POWER SUPPLY AND EQUIPMENT SHELF STRAPPING.

2-30. TRANSISTOR POWER SUPPLIES. The only strapping required on the transistor power supplies (fig. 2-3) is the arrangement of the transformer primary winding to operate on the proper line voltage. Each transistor power supply must be strapped for the proper line voltage as illustrated in configurations A and B of figure 2-4.

2-31. LINE BATTERY SUPPLIES. The line battery supplies involve both primary ac and dc output strapping. Primary ac strapping is accomplished in accordance with the procedures described in paragraph 2-32. The dc output strapping, for polar or neutral options, is accomplished in accordance with the procedure described in paragraph 2-33.

2-32. AC Input Strapping. The line battery supplies installed in power supply panels 2A7 and 2A8 (fig. 2-10) are used to provide 120 vdc neutral keying output and are strapped in the conventional manner to operate on the proper line voltage as illustrated in configurations A

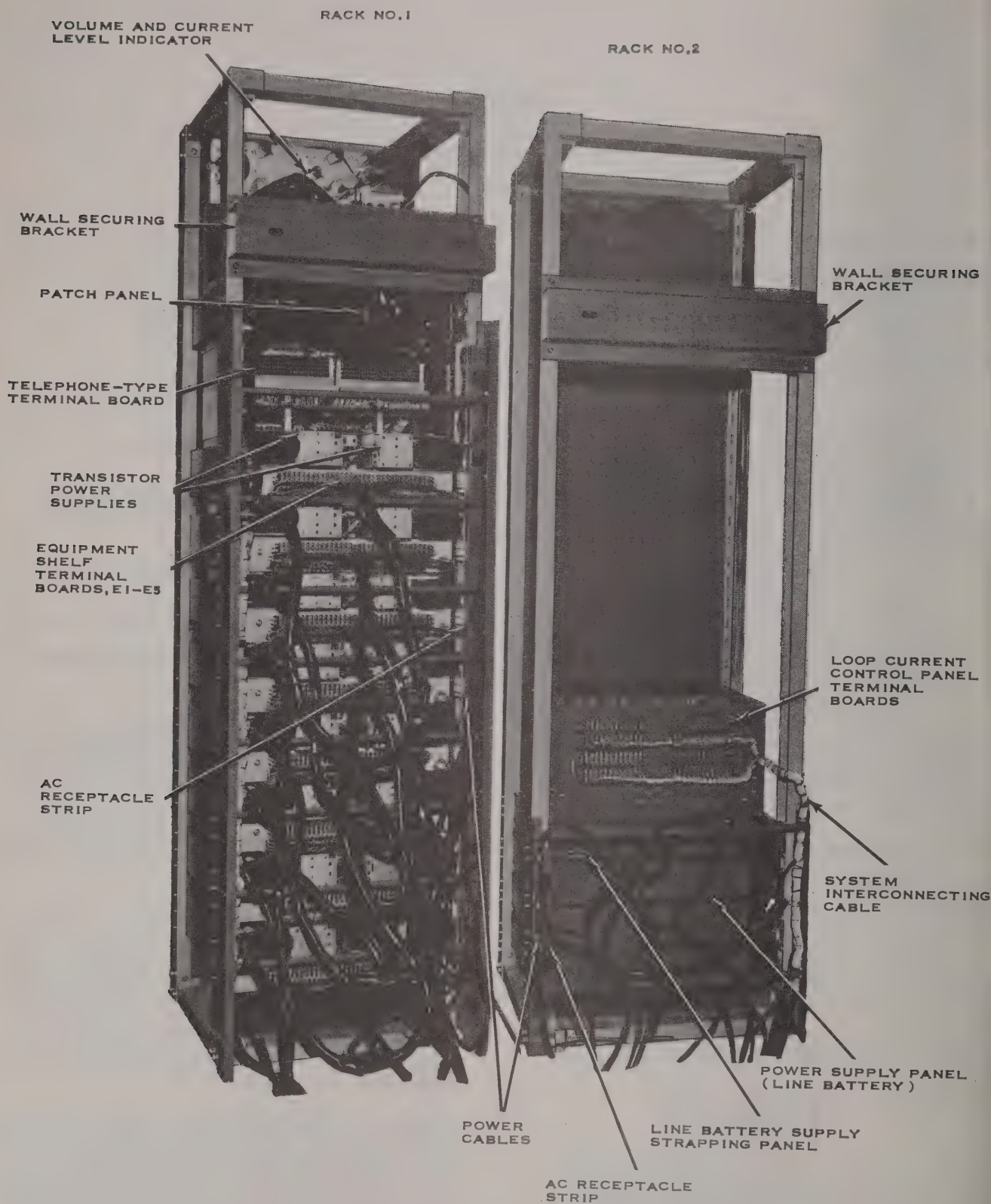


Figure 2-3. Equipment Rack No. 1 and No. 2, Rear View

and B of figure 2-4. The line battery supplies installed in power supply panels 2A9 and 2A10 (fig. 2-10) are used to provide the ± 60 volt polar keying output by strapping them for a 230 vac input and operating them with 115 vac. This manner of strapping reduces the normal output of 120 vdc to 60 vdc. For ± 60 vdc polar keying, strap and operate the polar line battery supplies as shown in configuration C of figure 2-4. If only 230 vac primary power is available, then strap the polar line battery supplies as shown in configuration D of figure 2-4.

2-33. DC Output Strapping. The dc outputs of the power supply panels are connected to the line battery strapping panel located on the rear of equipment rack no. 2 (fig. 2-3). Proper strapping of this panel enables the VFTG group to operate with polar and/or neutral keying outputs simultaneously. The keying output provided by the 12 tone converters comprised within a given voice channel will be identical; however, the entire channel may be wired to provide either a polar or neutral keying output.

2-34. Each channel within the VFTG group is strapped to provide the desired keying output (fig. 2-5). For example, if channel A is to be wired for polar operation, the following terminals are strapped together: A2 to A3, A5 to A6, and A7 to A8, as in configuration A. In contin-

uation, if channel B is to be wired for neutral operation, the following terminals are strapped together: B1 to B2 and B4 to B5 as in configuration B.

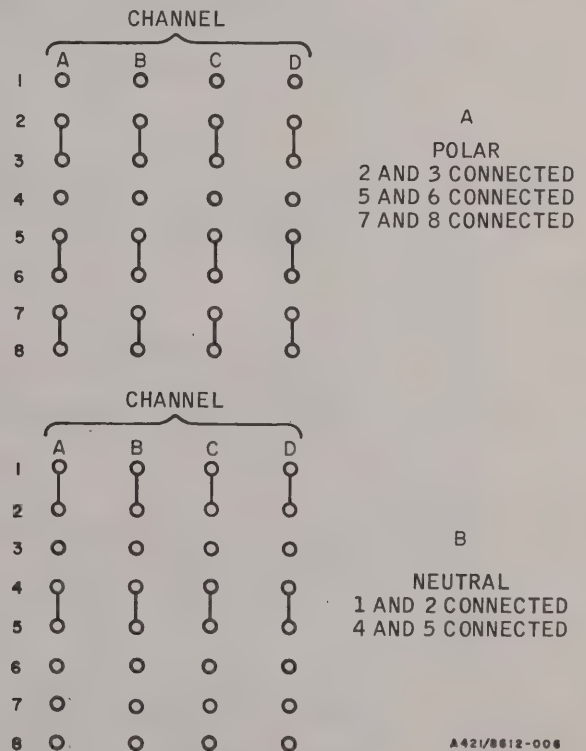
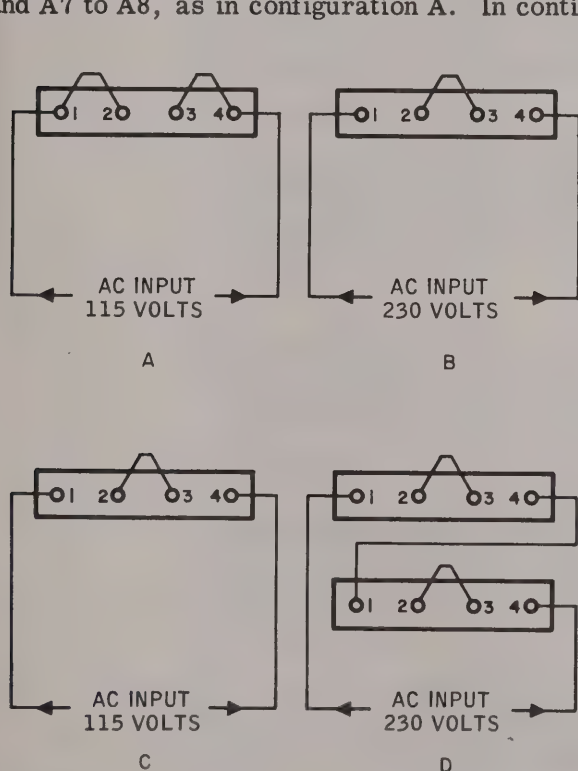
2-35. EQUIPMENT SHELF STRAPPING. The equipment shelf terminal boards (E1-E5, fig. 2-3) on the rear of each shelf must be strapped to connect the multiplex audio signals and line battery voltages to their respective input and output circuits. These terminal boards must be strapped as illustrated in figure 2-6.

2-36. EQUIPMENT RACK NO. 1 INSTALLATION.

2-37. This paragraph gives the procedural steps necessary to install equipment rack no. 1. Input and output signal lines are connected to telephone-type terminal boards on the rear of the patch panel (fig. 2-3). To install the equipment rack, proceed as follows:

a. Secure the four resilient shock mounts to the mounting plate as shown in figure 2-2.

b. Position the mounting plate on the floor in the area in which the equipment rack is to be installed. Secure the plate in place by bolting it to the floor (fig. 2-1).



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Figure 2-4. Power Supply Strapping

Figure 2-5. Line Battery Supply Strapping Panel

c. Mount the two resilient shock mounts on the wall as illustrated in figure 2-1.

d. Construct the shock mount locating template illustrated in figure 2-1.

NOTE

If the equipment rack is installed in a van, perform the following steps outside the van.

e. Secure the equipment rack to a fork lift, raise 18 inches, and block up to secure in place.

f. Secure the shock mount to the bottom of the equipment rack.

g. Lift the equipment rack off the blocks and position in front of the area in which it is to be installed.

NOTE

When the equipment rack is installed in an area in which the interconnecting terminal boards are accessible, position and secure the rack in place. However, if the terminal boards will not be accessible, position the rack in front of the area in which it is to be installed and proceed with the cable connections as outlined in steps j through n.

h. Using a fork lift, or four men, lift the equipment rack and place on the four shock mounts (fig. 2-1).

i. Secure the wall mounted shock mounts to the rear of the equipment rack.

NOTE

The external signal cable is connected to the telephone-type signal boards on the rear of equipment rack no. 1 in accordance with standard telephone practices.

j. Connect the dc teletype transmitter input lines and composite audio output lines to the multiplexer set to terminal board no. 1, see table 2-2 for connections.

k. Connect the composite audio input lines from the multiplexer set and dc output lines to the teleprinter to terminal board no. 2, see table 2-2 for connections.

l. Route the system interconnecting cable through any special ducts or troughs provided to the area in which equipment rack no. 2 is to be connected.

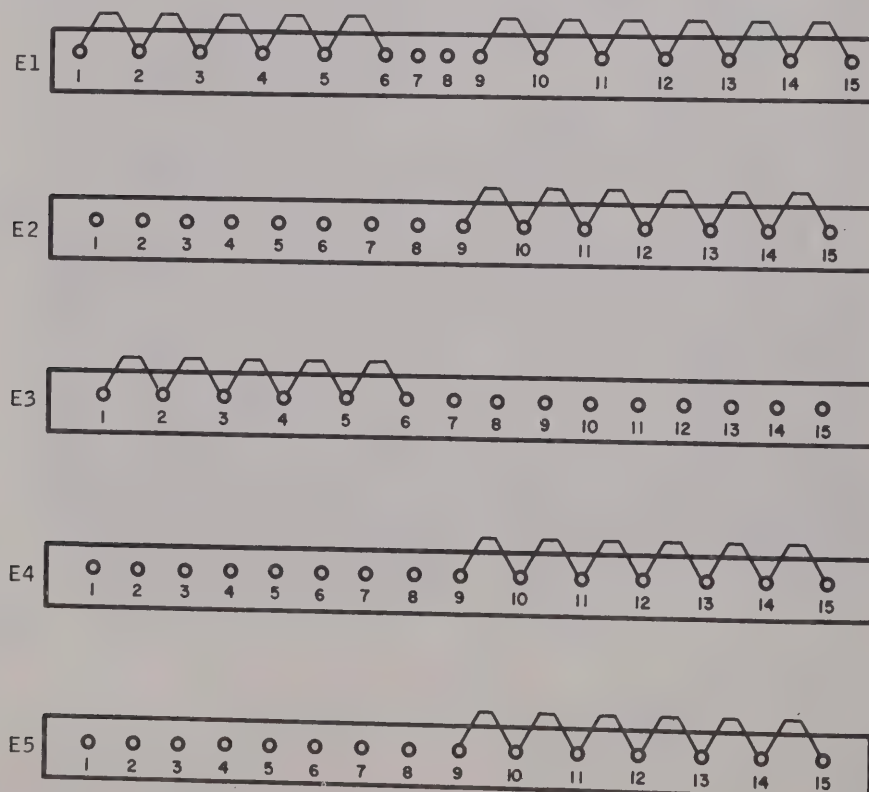


Figure 2-6. Equipment Shelf Strapping

m. Connect a ground cable (AWG #6 copper wire) between equipment rack no. 1 and the station ground bus.

WARNING

Make certain that station power is not applied to the receptacle in which the primary power cord on equipment rack no. 1 is connected.

n. Connect the ac power cord, attached to the bottom of the ac receptacle strip (rack no. 1, fig. 2-3) to the primary power.

2-38. EQUIPMENT RACK NO. 2 INSTALLATION.

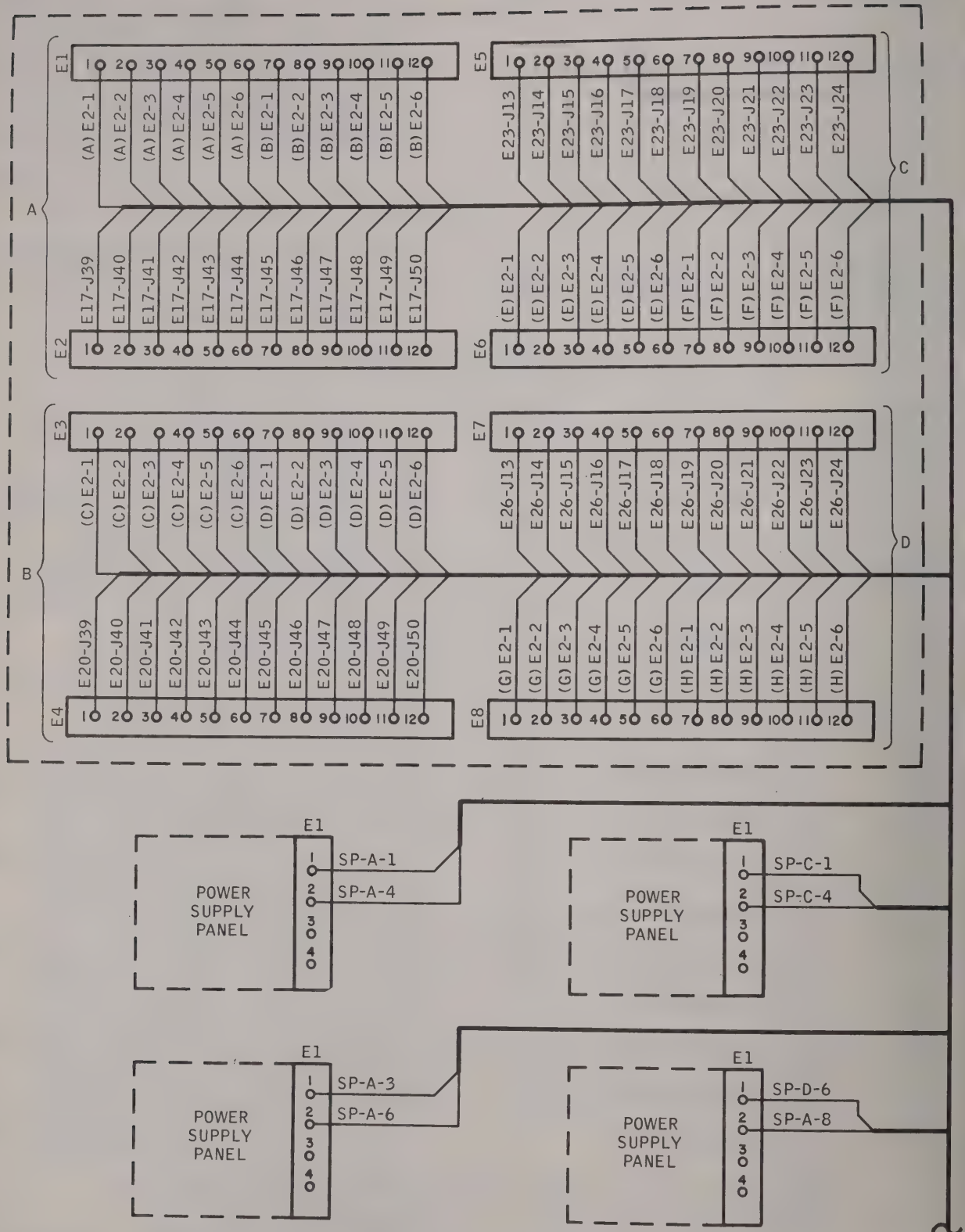
2-39. This paragraph gives the procedural steps necessary to install equipment rack no. 2. The systems interconnecting cable is connected to terminal boards on the rear of the loop current control panel, power supply panel, and line battery strapping panel (fig. 2-3). To install equipment rack no. 2, proceed as follows:

a. Perform steps a through i of paragraph 2-37.

b. Connect the system interconnecting cable to the terminal board on the loop current control panel and line battery power supply panels as illustrated in figure 2-7.

Table 2-2. Signal Cable Connections, VFTG Group

Board	Terminal	Channel	Signal
1	E1-1 through E1-12	A	Tone Keyers 1 through 12 LINE IN
1	E1-13	A	Tone Keyers 1 through 12 LINE OUT
1	E2-1 through E2-12	A	Tone Keyers 1 through 12 LINE IN common
1	E2-13	A	Tone Keyers 1 through 12 LINE OUT common
1	E3-1 through E3-12	B	Tone Keyers 1 through 12 LINE IN
1	E3-13	B	Tone Keyers 1 through 12 LINE OUT
1	E4-1 through E4-12	B	Tone Keyers 1 through 12 LINE IN common
1	E4-13	B	Tone Keyers 1 through 12 LINE OUT common
1	E5-1 through E5-12	C	Tone Keyers 1 through 12 LINE IN
1	E5-13	C	Tone Keyers 1 through 12 LINE OUT
1	E6-1 through E6-12	C	Tone Keyers 1 through 12 LINE IN common
1	E6-13	C	Tone Keyers 1 through 12 LINE OUT common
1	E7-1 through E7-12	D	Tone Keyers 1 through 12 LINE IN
1	E7-13	D	Tone Keyers 1 through 12 LINE OUT
1	E8-1 through E8-12	D	Tone Keyers 1 through 12 LINE IN common
1	E8-13	D	Tone Keyers 1 through 12 LINE OUT common
2	E9-1 through E9-12	A	Tone Converters 1 through 12 dc output
2	E9-13	A	Tone Converters 1 through 12 LINE IN
2	E10-1 through E10-12	A	Tone Converters 1 through 12 dc output common
2	E10-13	A	Tone Converters 1 through 12 LINE IN
2	E11-1 through E11-12	B	Tone Converters 1 through 12 dc output
2	E11-13	B	Tone Converters 1 through 12 LINE IN
2	E12-1 through E12-12	B	Tone Converters 1 through 12 dc output common
2	E12-13	B	Tone Converters 1 through 12 LINE IN
2	E13-1 through E13-12	C	Tone Converters 1 through 12 dc output
2	E13-13	C	Tone Converters 1 through 12 LINE IN
2	E14-1 through E14-12	C	Tone Converters 1 through 12 dc output common
2	E14-13	C	Tone Converters 1 through 12 LINE IN
2	E15-1 through E15-12	D	Tone Converters 1 through 12 dc output
2	E15-13	D	Tone Converters 1 through 12 LINE IN
2	E16-1 through E16-12	D	Tone Converters 1 through 12 dc output common
2	E16-13	D	Tone Converters 1 through 12 LINE IN
	E28-1		TDMS Transmitter IN
	E28-2		TDMS Transmitter IN common
	E28-3		TDMS Receiver IN
	E28-4		TDMS Receiver IN common



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Figure 2-7. Cable Connections, Loop Current Control Panel and Line Battery Supplies

c. Connect the 20-wire branch of the system interconnecting cable to the line battery strapping panel as listed in table 2-3.

Table 2-3. System Interconnecting Cable Connections, Line Battery Strapping Panel

Wire	Connect to Terminal	Wire	Connect to Terminal
(J) E1-1	A1	(C) E3-1	B7
(A) E1-1	A2	(K) E1-1	C1
(L) E1-1	A3	(E) E1-1	C2
(J) E1-2	A4	(K) E1-2	C4
E17-J50	A5	E23-J24	C5
(L) E102	A6	(E) E301	C7
(A) E3-1	A7	(G) E1-1	D2
(M) E1-2	A8	E26-J24	D4
(C) E3-1	B2	(M) E1-1	D5
E20-J50	B4	(G) E3-1	D6

WARNING

Make certain that station power is not applied to the receptacle in which the primary power cord on equipment rack no. 2 is attached.

f. Connect the ac power cord, attached to the bottom of the ac receptacle strip (rack no. 2, fig. 2-3) to the primary power.

NOTE

If the equipment rack is installed in an inaccessible area, slide it into position and secure in place.

d. Connect the primary ac power cords for each power supply panel to the ac receptacles strip, located in the rear of the equipment rack.

e. Connect a ground cable (AWG #6 copper wire) between equipment rack no. 2 and the station ground bus.

2-40. TONE KEYSER AND TONE CONVERTER INSTALLATION.

2-41. The tone keyers and tone converters comprised in the VFTG group are installed in the eight equipment shelves in equipment rack no. 1 (fig. 2-8). Six tone keyers and six tone converters are installed on each equipment

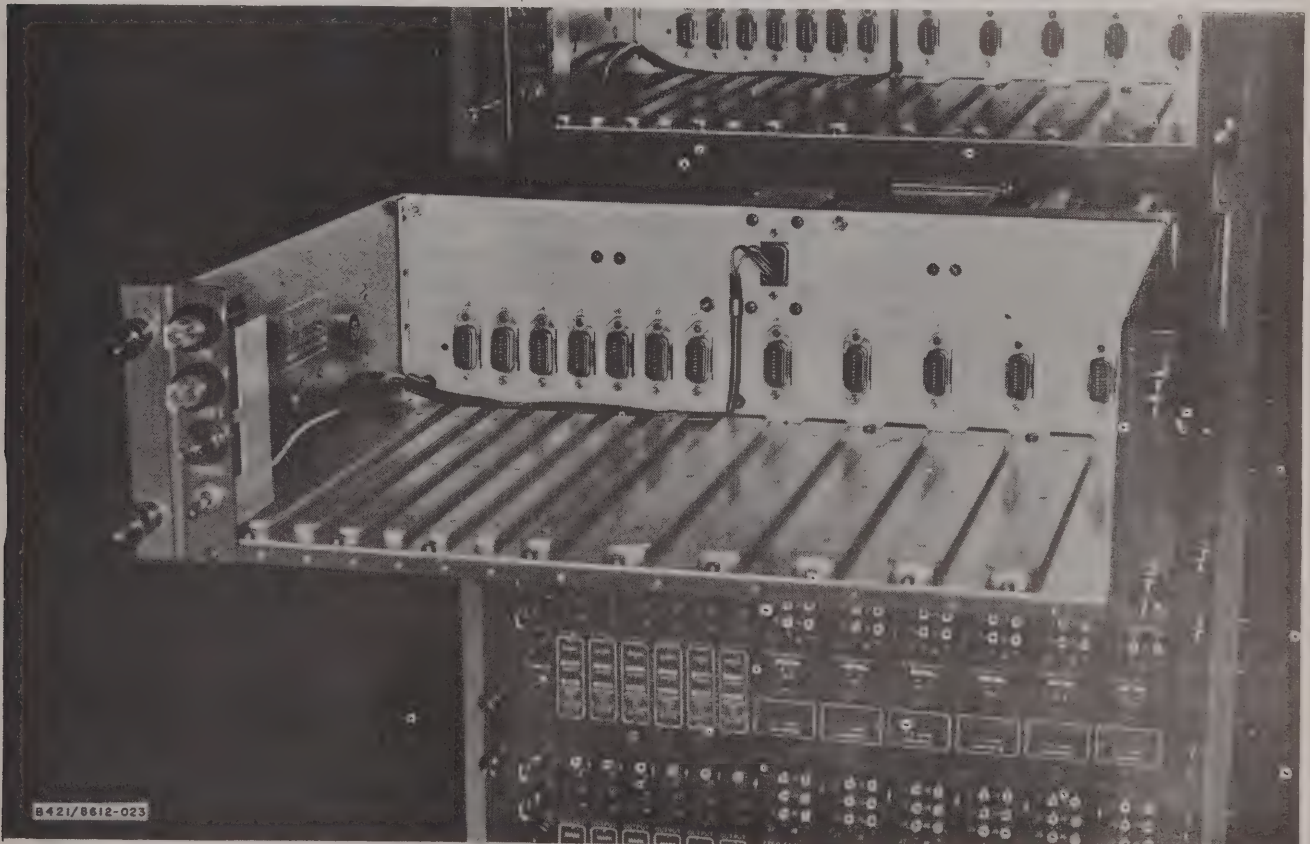


Figure 2-8. Equipment Shelf

shelf in the order of increasing frequency. The location and reference designation of the individual units are illustrated in figures 2-9 and 2-10. The operating frequency and frequency determining network for each tone keyer and tone converter are listed in table 2-4.

2-42. To install the tone keyers and tone converters proceed as follows:

NOTE

Refer to figure 2-9 and table 2-4 to perform these procedures.

a. Insert the appropriate tone keyer in posi-

tion 1A3A2 of the equipment shelf and slide forward until the plug on the rear of the unit engages the receptacle on the equipment shelf.

b. Secure the tone keyer in position by tightening the knurled thumbscrew on the bottom of each unit.

c. Repeat steps a and b for the remaining tone keyers and tone converters in the equipment shelves.

2-43. ALIGNMENT AND TEST PROCEDURES.

2-44. Refer to Chapter 5 of this manual for alignment and test procedures.

Table 2-4. Tone Keyer and Tone Converter Frequency Assignments (see fig. 2-9)

Equipment	Manufacturers Type	Location	Center Frequency (cps)	Frequency Determining Network
Tone Keyer -1	211Z5	1A3A1, 1A5A1, 1A7A1, 1A9A1	935	NRC-642
Tone Keyer -2	211Z6	1A3A2, 1A5A2, 1A7A2, 1A9A2	1105	NRC-643
Tone Keyer -3	211Z7	1A3A3, 1A5A3, 1A7A3, 1A9A3	1275	NRC-644
Tone Keyer -4	211Z8	1A3A4, 1A5A4, 1A7A4, 1A9A4	1445	NRC-645
Tone Keyer -5	211Z9	1A3A5, 1A5A5, 1A7A5, 1A9A5	1615	NRC-646
Tone Keyer -6	211Z10	1A3A6, 1A5A6, 1A7A6, 1A9A6	1785	NRC-647
Tone Keyer -7	211Z11	1A4A1, 1A6A1, 1A8A1, 1A10A1	1955	NRC-648
Tone Keyer -8	211Z12	1A4A2, 1A6A2, 1A8A2, 1A10A2	2125	NRC-649
Tone Keyer -9	211Z13	1A4A3, 1A6A3, 1A8A3, 1A10A3	2295	NRC-650
Tone Keyer -10	211Z14	1A4A4, 1A6A4, 1A8A4, 1A10A4	2465	NRC-651
Tone Keyer -11	211Z15	1A4A5, 1A6A5, 1A8A5, 1A10A5	2635	NRC-652
Tone Keyer -12	211Z16	1A4A6, 1A6A6, 1A8A6, 1A10A6	2805	NRC-653
Tone Converter -1	212Z5	1A3A7, 1A5A7, 1A7A7, 1A9A7	935	NRC-698
Tone Converter -2	212Z6	1A3A8, 1A5A8, 1A7A8, 1A9A8	1105	NRC-699
Tone Converter -3	212Z7	1A3A9, 1A5A9, 1A7A9, 1A9A9	1275	NRC-700
Tone Converter -4	212Z8	1A3A10, 1A5A10, 1A7A10, 1A9A10	1445	NRC-701
Tone Converter -5	212Z9	1A3A11, 1A5A11, 1A7A11, 1A9A11	1615	NRC-702
Tone Converter -6	212Z10	1A3A12, 1A5A12, 1A7A12, 1A9A12	1785	NRC-703
Tone Converter -7	212Z11	1A4A7, 1A6A7, 1A8A7, 1A10A7	1955	NRC-704
Tone Converter -8	212Z12	1A4A8, 1A6A8, 1A8A8, 1A10A8	2125	NRC-705
Tone Converter -9	212Z13	1A4A9, 1A6A9, 1A8A9, 1A10A9	2295	NRC-706
Tone Converter -10	212Z14	1A4A10, 1A6A10, 1A8A10, 1A10A10	2465	NRC-707
Tone Converter -11	212Z15	1A4A11, 1A6A11, 1A8A11, 1A10A11	2635	NRC-708
Tone Converter -12	212Z16	1A4A12, 1A6A12, 1A8A12, 1A10A12	2805	NRC-709

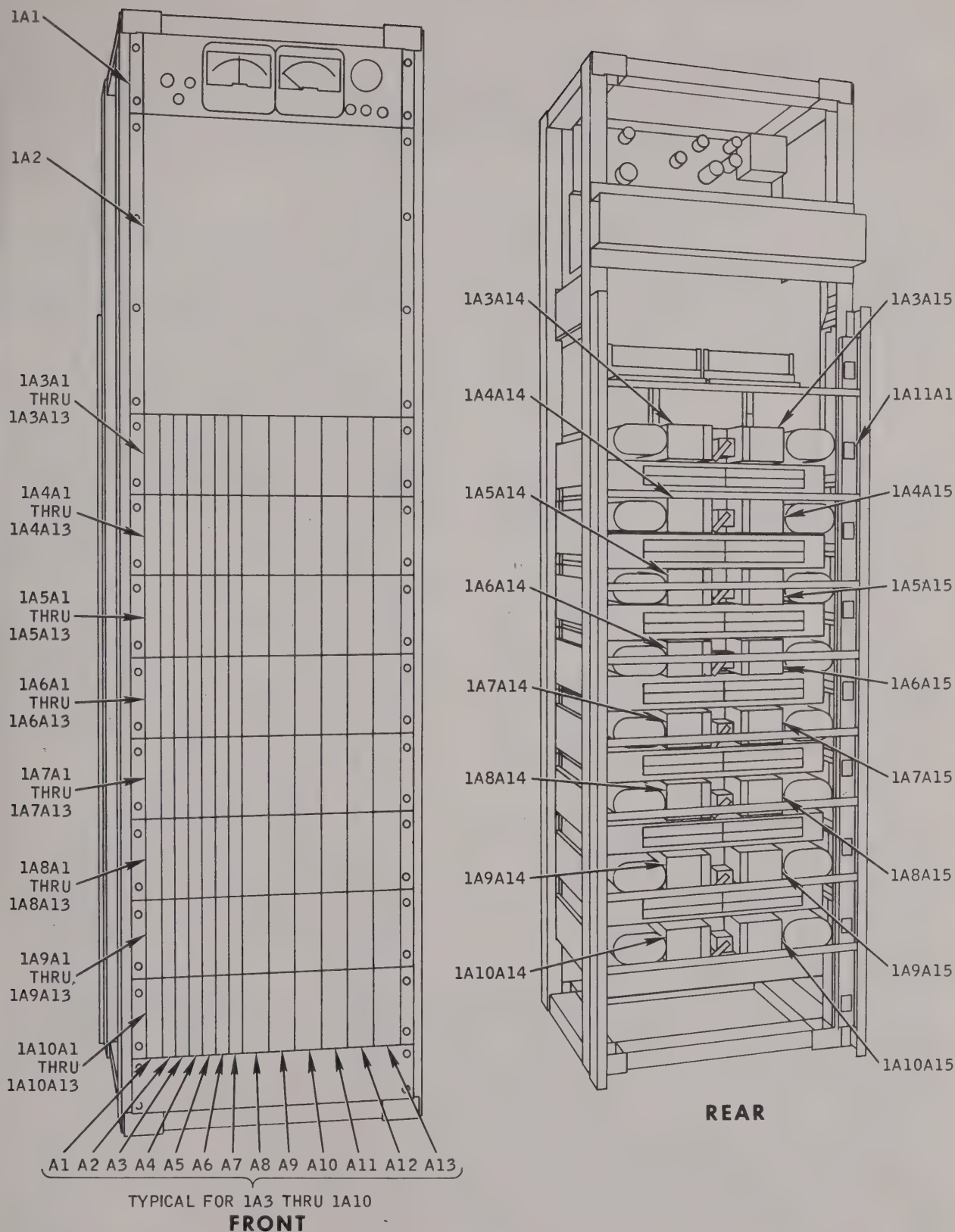
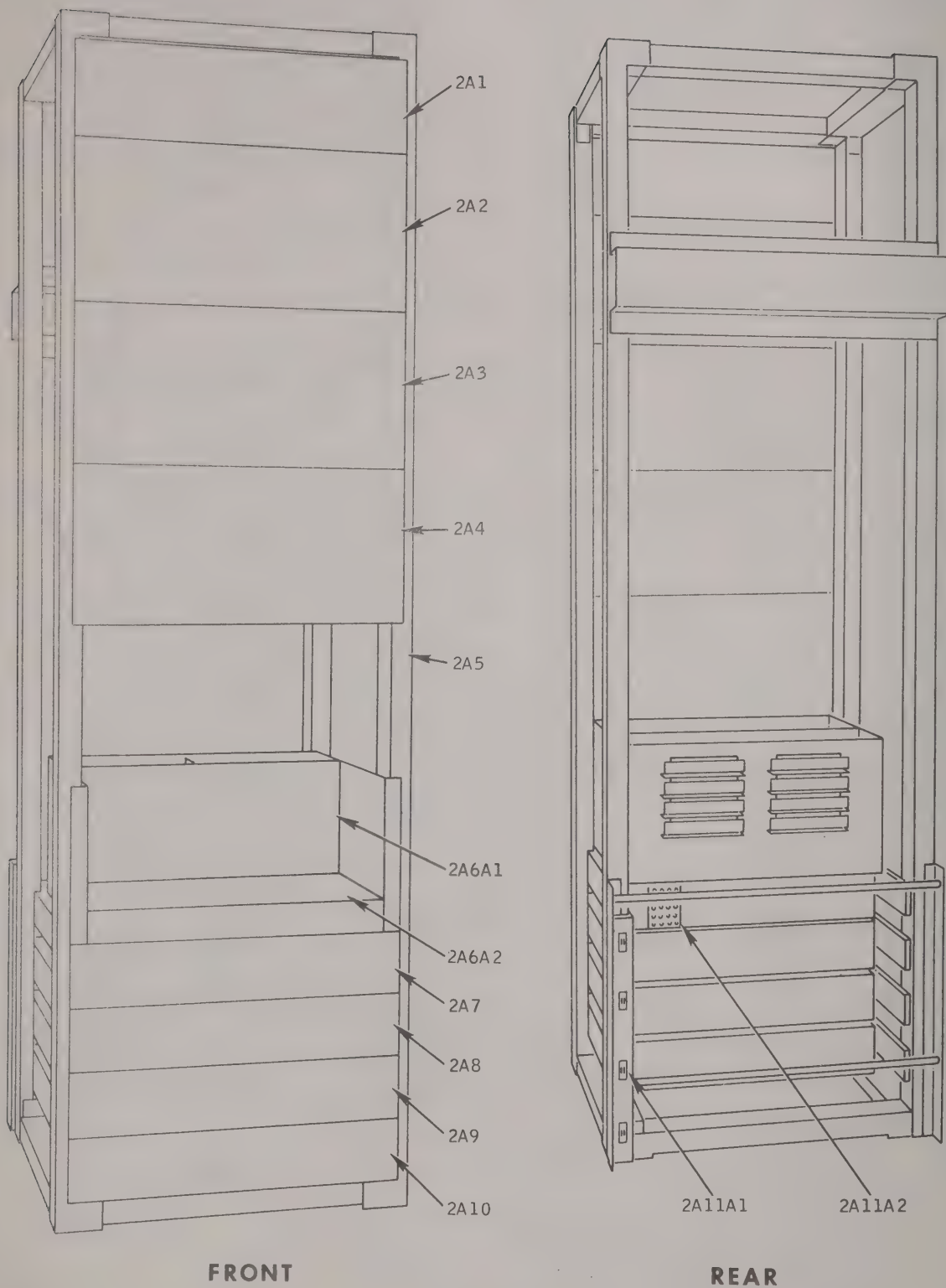


Figure 2-9. Reference Designations, Equipment Racks No. 1



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Figure 2-10. Reference Designations, Equipment Racks No. 2

SECTION IV

PREPARATION FOR RESHIPMENT

2-45. GENERAL.

2-46. This section contains instructions for preparation of the VFTG group for reshipment by any standard cargo carrier.

2-47. DISASSEMBLY INSTRUCTIONS.

2-48. During preparation of the equipment for reshipment, whenever possible, leave all fasteners (such as bolts) attached to the components with which they belong. Group together all hardware and package it in cloth bags. Label all such packages clearly and take every precaution against loss during loading and shipping.

2-49. Whenever possible use the original shipping containers. If these crates are not available, containers of suitable size and construction must be acquired from local sources; refer to table 2-1 for crate requirements. When the equipment is prepared for shipment, properly mark each container and list its contents.

WARNING

Before proceeding with the disassembly, make certain that station power to the VFTG group has been turned off and that the primary power cable has been disconnected from the power source.

2-50. EQUIPMENT.

2-51. Only the tone keyers and tone converters are removed when the VFTG group must be reshipped. The tone keyers and tone converters are removed by loosening the knurled thumb-screw securing them to the equipment shelf and pulling the unit out.

2-52. CABLING.

2-53. EXTERNAL SIGNAL CABLE.

2-54. The signal cable connecting the teletype subscribers and multiplexer equipment to the VFTG group must be disconnected. When disconnecting this cable, attach a tag to each wire denoting the signal on it; do not cut or damage any of the wires on this cable during its removal.

2-55. SYSTEM INTERCONNECTING CABLE.

2-56. Remove the system interconnecting cable attached to equipment rack no. 2. When disconnecting this cable, attach a tag to each wire denoting the terminal from which it was removed.

NOTE

Do not remove any connections to the system interconnecting cable in equipment rack no. 1.

Do not cut or damage any of the wires in this cable during its removal, and do not remove any strapping jumpers.

CHAPTER 3
OPERATION

3-1. INTRODUCTION. This chapter furnishes the instructions you will need to operate the VFTG group properly. It is assumed that all the equipment has been aligned and adjusted in accordance with the procedures in Chapter 5 and that the sys-

tem is operative. The controls and indicators necessary to operate the VFTG group are listed and illustrated in Section I. The turn on, operating, and turn off procedures are described in Section II. Section III, Emergency Operation, is not applicable.

SECTION I
CONTROLS AND INDICATORS

3-2. IDENTIFICATION OF CONTROLS AND INDICATORS.

3-3. The controls and indicators used to maintain and operate the VFTG group are listed in tables 3-1 through 3-5 and are illustrated in figures 3-1 through 3-5 respectively. The various jacks on the patch panel are listed in table 3-6 and are illustrated in figure 3-6. The patch panel is divided into five sections as follows: A, B, C, D, and auxiliary. The A, B, C, and D portions each represent a voice

frequency channel which is a combination of 12 teletype subchannels; the auxiliary portion provides jacks used for connecting to test equipment and special patching loops. Because the signal jacks are identical in each of the 4 channels, only the channel A portion is discussed. The auxiliary jacks are listed as they appear.

3-4. The test points on the tone keyers, tone converters, and transistor power supplies are listed in table 3-7 and are illustrated in figures 3-1 and 3-2.

Table 3-1. Equipment Shelves, Controls and Indicators (fig. 3-1)

Name	Reference Designation	Function
POWER switch	S1	Applies primary ac power to equipment shelf
POWER indicator	DS1	Lights to indicate ac power is applied to equipment shelf power supplies
FUSE 1 indicator	F1	Lights to indicate fuse 1 blown in ac primary of equipment shelf power supplies
FUSE 2 indicator	F2	Lights to indicate fuse 2 blown in ac primary of equipment shelf

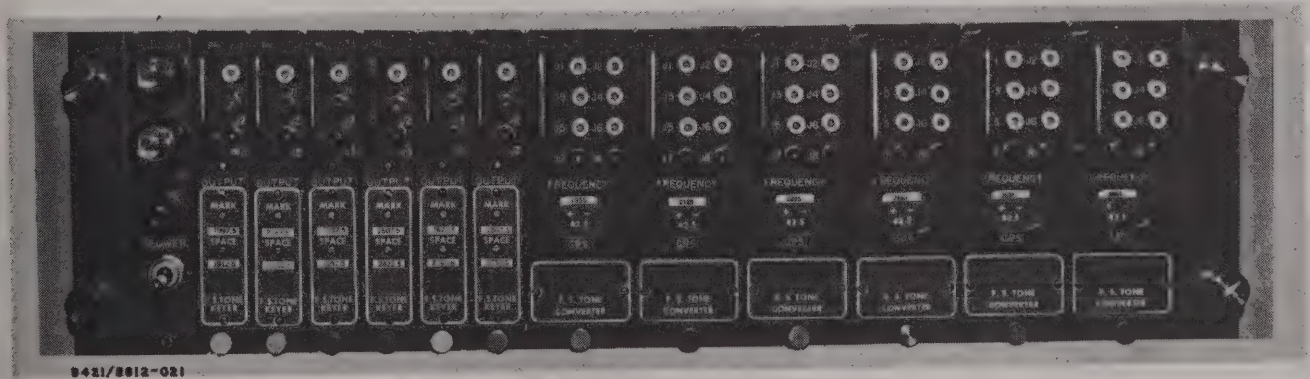


Figure 3-1. Equipment Shelves, Controls and Indicators

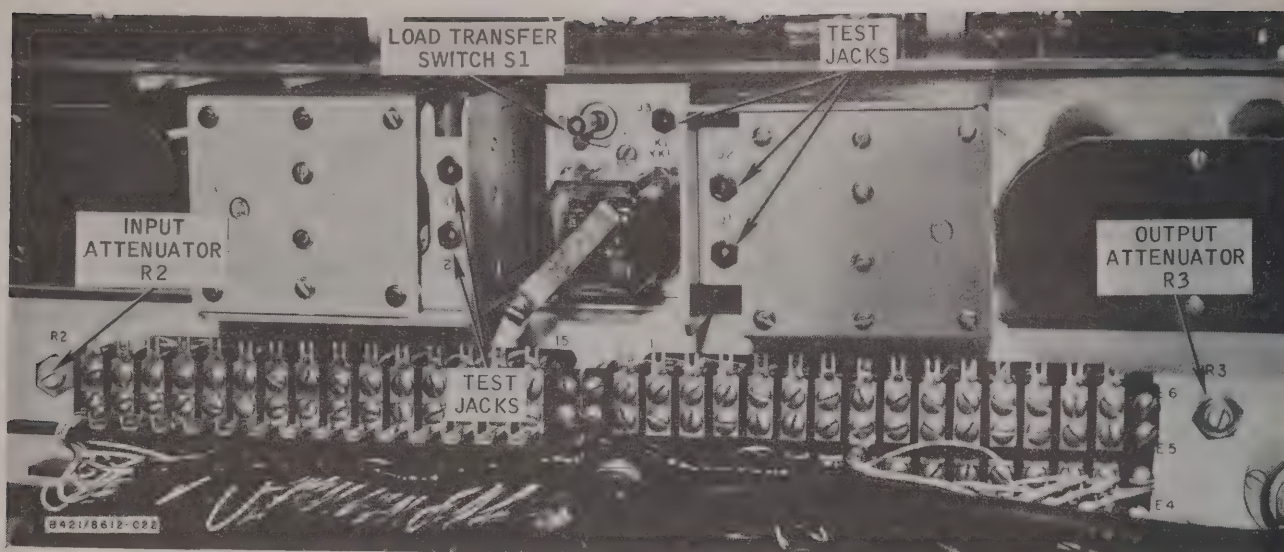


Figure 3-2. Equipment Shelf, Rear Panel, Controls and Indicators

Table 3-2. Equipment Shelves, Rear View, Controls and Indicators (fig. 3-2)

Name	Reference Designation	Function
LOAD TRANSFER switch	S1	Selects dc output of transistor power supply no. 1 or 2 for connection to load
Input attenuator	R2	Adjusts level of composite audio signals applied to tone converters in the equipment shelf
Output attenuator	R3	Adjusts output level of audio tones generated by tone keys in the equipment shelf

Table 3-3. Line Battery Power Supply Panel, Controls and Indicators (fig. 3-3)

Name	Reference Designation	Function
POWER ON/OFF switch	S2	Applies primary ac power to line battery supplies
LOAD TRANSFER switch	S1	Selects dc output of line battery supply 1 or 2 for connection to load
D.C. OUTPUT SUPPLY NO. 1	DS1	Lights to indicate dc voltage at the output of line battery supply 1
D.C. OUTPUT SUPPLY NO. 2	DS2	Lights to indicate dc voltage at the output of line battery supply 2
SUPPLY No. 1 fuse indicator	F1	Lights to indicate fuse 1 blown in line battery supply 1 ac primary
SUPPLY No. 2 fuse indicator	F2	Lights to indicate fuse 2 blown in line battery supply 2 ac primary
+D.C. OUTPUT SUPPLY NO. 1 fuse indicator	F3	Lights to indicate fuse 3 blown in line battery supply 1 dc output
-D.C. OUTPUT SUPPLY NO. 1 fuse indicator	F4	Lights to indicate fuse 4 blown in line battery supply 1 dc output
+D.C. OUTPUT SUPPLY NO. 2 fuse indicator	F5	Lights to indicate fuse 5 blown in line battery supply 2 dc output
-D.C. OUTPUT SUPPLY NO. 2 fuse indicator	F6	Lights to indicate fuse 6 blown in line battery supply 2 dc output

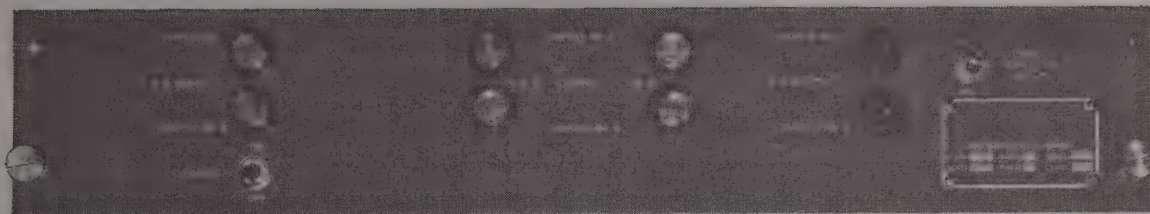


Figure 3-3. Power Supply Panel, Controls and Indicators

Table 3-4. Loop Current Control Panel, Controls and Indicators (fig. 3-4)

Name	Reference Designation	Function
T. C. 1-1 through T. C. 1-12 resistors	2A6A1 (R1 through R12)	Regulates output loop current for tone converters 1 through 12 in Channel A
T. C. 1-1 through T. C. 1-12 fuse indicators	2A6A1 (F1 through F12)	Lights to indicate fuses 1 through 12 blown in Channel A output loop circuit
T. C. 2-1 through T. C. 2-12 resistors	2A6A2 (R13 through R24)	Regulates output loop current for tone converters 1 through 12 in Channel B
T. C. 2-1 through T. C. 2-12 fuse indicators	2A6A2 (F13 through F24)	Lights to indicate fuses 12 through 24 blown in Channel B output loop circuit
T. C. 3-1 through T. C. 3-12 resistors	2A6A1 (R25 through R36)	Regulates output loop current for tone converters 1 through 12 in Channel C
T. C. 3-1 through T. C. 3-12 fuse indicators	2A6A1 (F25 through F36)	Lights to indicate fuses 25 through 36 blown in Channel C output loop
T. C. 4-1 through T. C. 4-12 resistors	2A6A2 (R37 through R48)	Regulates output loop current for tone converters 1 through 12 in Channel D
T. C. 4-1 through T. C. 4-12 fuse indicators	2A6A2 (F37 through F48)	Lights to indicate fuses 37 through 48 blown in Channel D output loop

Table 3-5. Volume and Current Level Indicator, Controls and Indicators (see fig. 3-5)

Name	Reference Designation	Function
POWER switch	(1A1)S2	Applies primary ac power to volume and current level indicator
TERMINATING INPUT/ BRIDGING INPUT switch	(1A1)S1	Terminating Input: Selects input impedance of 600Ω terminating Bridging Input: Selects input impedance of 2500Ω bridging
Attenuator	(1A1)R3	Establishes reference level (in volume units) for VU meter
POWER indicator	(1A1)DS1	Lights to indicate that ac is applied to volume and current level indicator

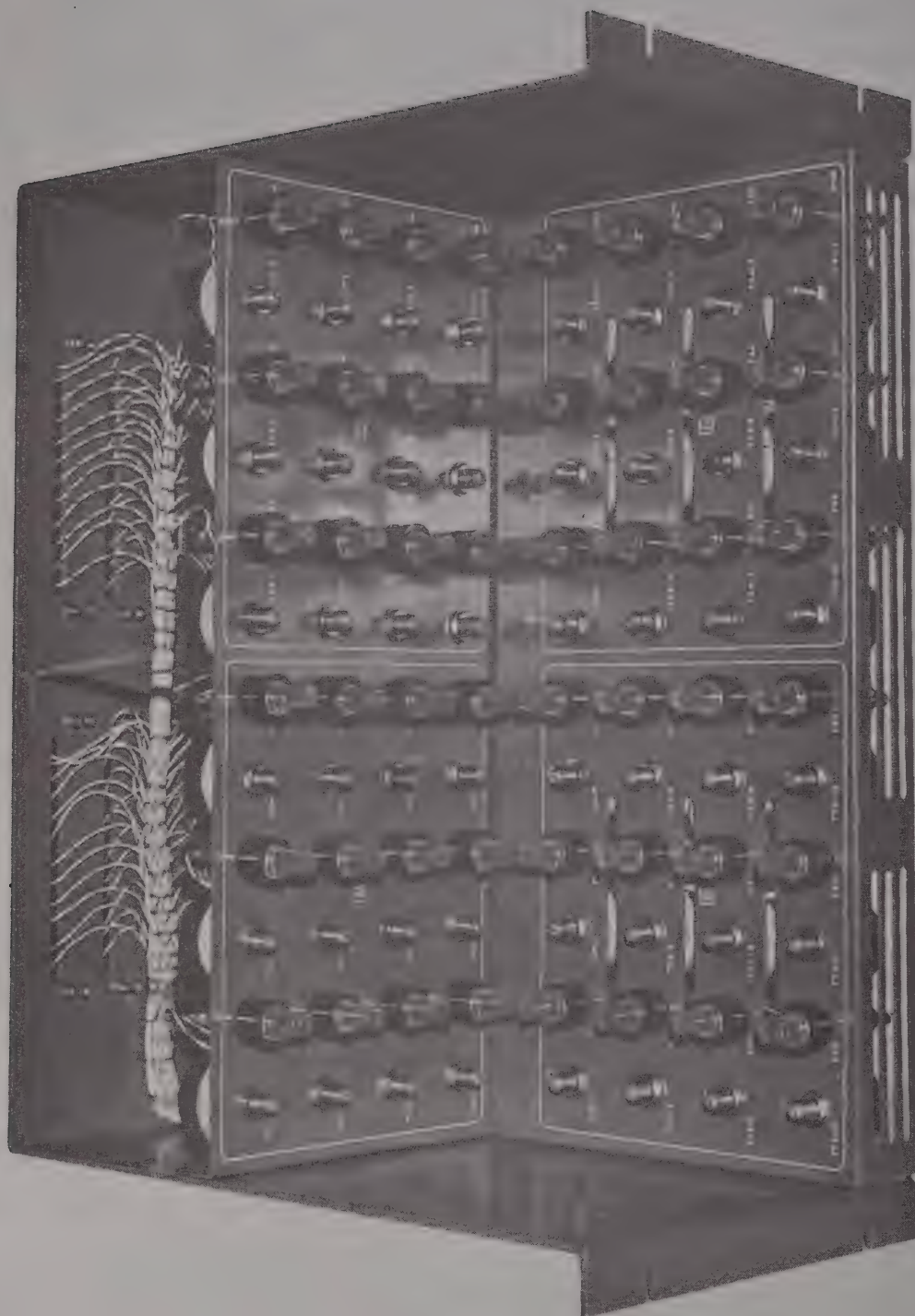


Figure 3-4. Loop Current Control Panel, Controls and Indicators

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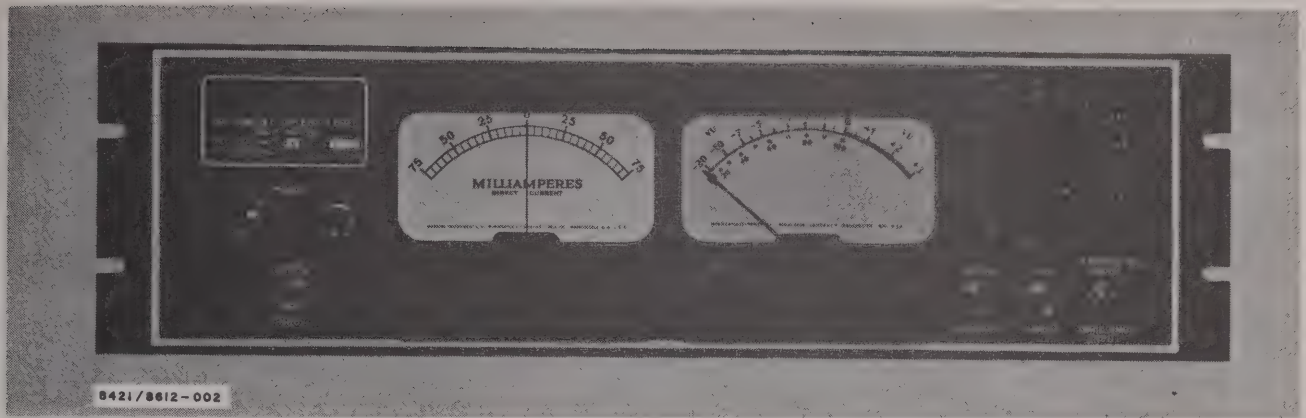


Figure 3-5. Volume and Current Level Indicator, Controls and Indicators

Table 3-6. Patch Panel, Jacks (fig. 3-6)

<u>Jack</u>	<u>Function</u>
TK1 IN MON through TK12 IN MON.....	Provides connection for monitoring input to corresponding tone keyer by series circuit connection to dc loop
TK1 EQUIP IN through TK12 EQUIP IN.....	Provides connection to input of corresponding tone keyer. When patch cord is inserted, the normal-through connection is broken
TK1 LINE IN through TK12 LINE IN	Provides connection to dc input line applied to corresponding tone keyer. When patch cord is inserted, the normal-through connection is broken
TK1 OUT through TK12 OUT.....	Provides connection to output of corresponding tone keyer. When patch cord is inserted, the normal-through connection is broken
TK EQUIP OUT jacks	Provides connection to combined output of tone keyers 1 through 12. When patch cord is inserted the normal-through connection is broken
TK MON OUT jacks	Provides connection to combined output of tone keyers 1 through 12 without breaking circuit connections to output line
TK LINE OUT jacks.....	Provides connection to composite audio output line. When patch cord is inserted, the normal-through connection is broken
TC IN MON jacks.....	Provides connection for monitoring composite audio input to tone converters 1 through 12 without breaking circuit connections from input line
TC EQUIP IN jacks	Provides connection to composite audio input to tone converters 1 through 12. When patch cord is inserted, the normal-through connection is broken
TC LINE jacks	Provides connection to composite audio input line. When patch cord is inserted, the normal-through connection is broken
TC1 IN through TC12 IN	Provides connection to audio input of corresponding tone converter. When patch cord is inserted, the normal-through connection is broken
TC1 EQUIP OUT through TC12 EQUIP OUT	Provides connection to dc output of corresponding tone converter. When patch cord is inserted, the normal-through connection is broken

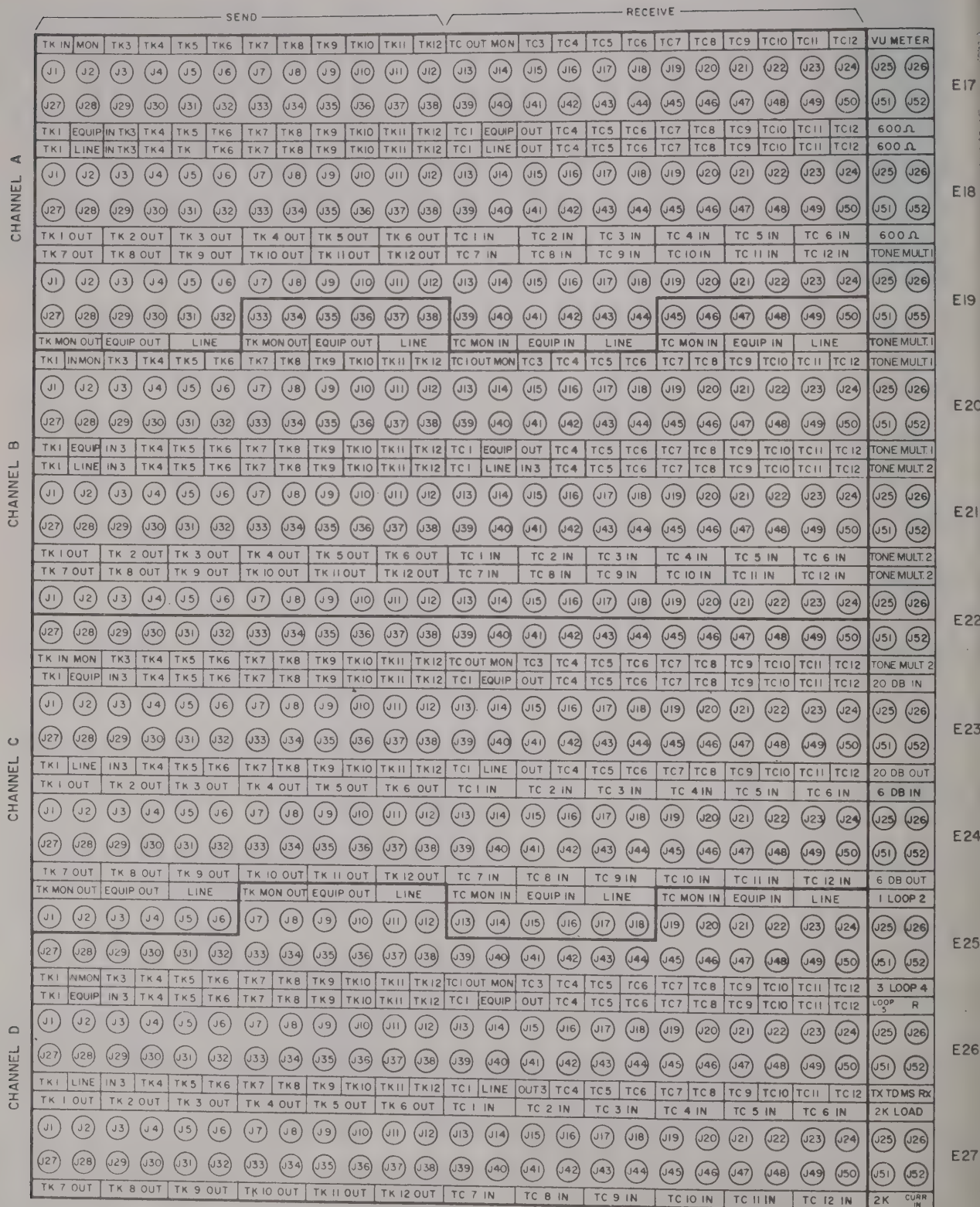


Figure 3-6. Patch Panel, Jackfield

Table 3-6. Patch Panel, Jacks (cont)

<u>Jack</u>	<u>Function</u>
TC1 MON OUT through TC12 MON OUT	Provides connection to dc output of corresponding tone converter without breaking connection to dc loop
TC1 LINE OUT through TC12 LINE OUT.....	Provides connection to dc output lines connected to corresponding tone converter. When patch cord is inserted, the normal-through connection is broken
VU METER jacks	Provides connection to audio input of volume and current level indicator
CURR IN jack.....	Provides connection to current meter in volume and current level indicator
600 Ω jacks	Provides connection to 620 Ω -1 watt termination resistor: for use in conjunction with volume and current level indicator
2K LOAD jacks	Provides dc connection to 2000 Ω termination resistor
20 DB IN jacks.....	Provides connection to input of 20 db attenuator
20 DB OUT jacks.....	Provides connection to output of 20 db attenuator
6 DB IN jacks.....	Provides connection to output of 6 db attenuator
LOOP 1, 2, 3, 4, 5, and R jacks	Provides six jacks for connecting singlewire dc unit in series; used in conjunction with volume and current level indicator
TONE MULT. 1 jacks	Provides four jacks for connecting two-wire audio units in parallel
TONE MULT. 2 jacks	Provides four jacks for connecting two-wire audio units in parallel
TX TDMS jack.....	Provides dc connection to TDMS test equipment transmitter
RX TDMS jack.....	Provides dc connection to TDMS test equipment receiver

Table 3-7. Test Jacks (see fig. 3-1 and 3-2)

<u>Unit/Test Point</u>	<u>Description</u>
Tone keyer (see fig. 3-1):	
J1	DC keying monitor
J2	Tone monitor
J3	Common
Tone converter (see fig. 3-1):	
J1	Input signal
J2	2nd limiter input
J3	3rd limiter input
J4	Discriminator output
J5	Output signal
J6	Collector voltage 3rd stage amplifier
J7	B- monitor
J8	B+ monitor, common*
Transistor power supply (see fig. 3-2):	
J1	B- monitor
J2	B+ monitor, common
Transistor power supply transistor power supply control:	
J3	B- monitor

*J8 is common connection for all test points except J1 (input signal). J8 is not returned to ground but to the positive side of the power supply. To check the input signal at J1, use chassis ground for common side of equipment.

SECTION II

OPERATING INSTRUCTIONS

3-5. PRELIMINARY CONTROL SETTINGS.

NOTE

It is assumed that the individual equipments comprised in the VFTG group have been aligned, in accordance with the procedures described in Chapter 5, and are in working condition.

3-6. To establish the preliminary control settings of the equipment comprised in the VFTG group, proceed as follows:

CAUTION

Do not apply primary power until preliminary control settings are completed.

- a. Set all POWER switches to OFF position.
- b. Check all cable connections for tightness.
- c. Apply station power to the VFTG group.

3-7. TURN ON PROCEDURE.

3-8. Power is applied to the VFTG group in accordance with the following turn on procedure:

- a. Set equipment shelf POWER switches (S1) to the on position (up). The indicator lamps (DS1) should illuminate.
- b. Set line battery supply POWER switches (S2) to the on position. The D.C. OUTPUT SUPPLY NO. 1 and D.C. OUTPUT SUPPLY NO. 2 should illuminate.
- c. Set POWER switch (S2) located on the volume and current level indicator, to the on position. The POWER indicator (DS1) should illuminate.

d. Check to be sure that no blown fuse indicators are illuminated.

NOTE

Before replacing fuses, set power switch, corresponding to illuminated indicator, to the off position.

3-9. TUNE UP PROCEDURE.

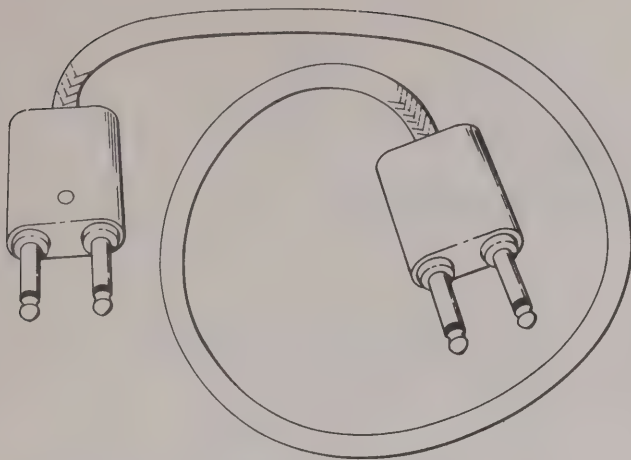
3-10. The VFTG group normally does not require adjustment each time it is turned on. However, upon completion of equipment maintenance, which may alter operation, or at the discretion of the station supervisor, perform the alignment procedure described in Chapter 5.

3-11. OPERATING PROCEDURE.

3-12. -GENERAL.

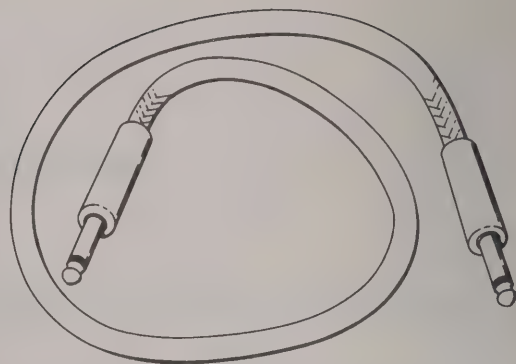
3-13. The VFTG group is placed in operation by applying power to the equipment in accordance with the procedure described in paragraph 3-8. The various subscribers are normally connected to their respective input and output circuits through the normal-through jack configuration in the patch panel jack field. However, these assignments can be altered by patching. The patching facilities also provide jacks for the purpose of monitoring the various signals within the VFTG group without interrupting subscriber service. The patching procedures, as related to operating the equipment, may be categorized into two functions: (1) signal patching, and (2) monitoring.

3-14. Audio signals within the VFTG group are carried on a two wire distribution system which is isolated from common ground. Isolation is maintained throughout the patching facilities by using two jacks for each audio line. A double prong audio patch cord (fig. 3-7) must be used when connecting to audio lines. The various audio signals may be patched individually or collectively.



AUDIO PATCH CORD

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DC PATCH CORD

Figure 3-7. Patch Cords

3-15. The dc teletype signals are carried on a single wire common ground distribution system (an isolated common circuit is used in polar keying circuits). A single prong dc patch cord (fig. 3-7) must be used when patching to dc lines. The dc signals cannot be combined and, therefore, must be individually patched.

NOTE

Do not perform any signal patching procedures without first consulting the station supervisor and informing him of the alterations to be made.

3-16. SIGNAL PATCHING.

3-17. The signal patching involves only that portion of the patch panel corresponding to the four channels, A, B, C, and D (para 3-3). To alter a signal path, the operator need only connect a patch cord between the signal source and the alternate input. When a patch cord is connected to the jacks designated as **LINE** or **EQUIP** the normal-through equipment assignment is broken. The patching procedures described herein may also be used to connect the various subscribers to an alternate traffic circuit. Because the jack field is identical for each channel, the discussion herein will be limited to channel A and B configurations.

NOTE

For purposes of explanation, channel B is assumed to be in a standby condition; the patching procedures described will be performed between channels A and B. Individual unit patching will be performed between tone keyer 1 (TK1) and/or tone converter 1 (TC1) of channels A and B respectively.

3-18. **AUDIO SIGNAL PATCHING.** The audio signals within the VFTG group may be patched individually or collectively, depending on the point of interception. An incoming channel consisting of twelve combined audio tones may be connected to an alternate input in accordance with the procedure described in paragraph 3-19. A twelve signal composite audio output, corresponding to one voice channel, may be connected to an alternate output in accordance with the procedure described in paragraph 3-20. Individual audio signals may be patched to an alternate input or output in accordance with the procedures described in paragraphs 3-21 and 3-22.

NOTE

All input audio signals are composite tones and are connected to the tone converters. When connecting the input of one tone converter to an alternate input, the alternate unit will receive the composite signal. The tone signals generated by the tone keyers may be intercepted individually or collectively as determined by the point of interception.

3-19. To connect the incoming composite audio signal applied to channel A to the alternate input (channel B), proceed as follows:

- a. Insert an audio patch cord in the jack designated **TC EQUIP** in the channel B portion of the patch panel; this removes the normal input from TC1 through TC12 in channel B.
- b. Insert the other end of the audio patch cord in the jack designated **LINE** in the channel

A portion of the patch panel; this disconnects the composite audio input from channel A and connects it to the channel B input.

3-20. To connect the composite audio output from the tone keyers in channel A to the alternate output line of channel B, proceed as follows:

a. Connect an audio patch cord to the jack designated TK LINE OUT in the channel B portion of the patch panel; this disconnects the composite audio output of channel B from the output line.

b. Connect the other end of the audio patch cord to the jack designated TK OUT in the channel A portion of the patch panel; this connects the composite audio output of TK1 through TK12 in channel A to the channel B output line.

3-21. To connect the composite audio signal applied to the tone converters in channel A to an alternate or standby tone converter in channel B, proceed as follows:

NOTE

The tone converters are each tuned to a specific center frequency. Therefore, when selecting an alternate input, only units tuned to the same frequency may be interchanged.

a. Connect an audio patch cord to the jack designated TC1 IN on the channel B portion of the patch panel; this disconnects TC1 from the channel B audio input.

b. Connect the other end of audio patch cord to the jack designated TC MON IN on the channel A portion of the patch panel; this connects the composite audio input from channel A to the alternate unit in channel B.

3-22. To disconnect the output of a single tone keyer from the channel B composite output line and connect it to the channel A output line proceed as follows:

NOTE

The frequency shift tone keyers are each tuned to a specific center frequency. Therefore, when selecting an alternate output, only units tuned to the same frequency may be interchanged.

a. Connect an audio patch cord to the jack designated TK1 LINE OUT in the channel A portion of the patch panel; this disconnects the output of TK1 in channel A from the composite audio output line.

b. Connect the other end of the audio patch cord to the jack designated TK1 EQUIP OUT in the channel B portion of the patch panel; this disconnects the output of TK1 from the channel B output line and connects it to the channel A composite audio output line.

3-23. TELETYPE SIGNAL PATCHING. The dc teletype signals within the VFTG group are each patched individually. An incoming teletype signal, as received from a single subscriber, may be patched to an alternate input in accordance with the procedure described in paragraph 3-24. The dc teleprinter output signals, developed by the tone converters, may be connected to an alternate output in accordance with the procedure described in paragraph 3-25.

3-24. To connect an incoming teletype signal applied to a tone keyer in channel A to an alternate tone keyer in channel B, proceed as follows:

a. Insert a dc patch cord in the jack designated TK1 EQUIP IN on the channel B portion of the patch panel; this removes the normal input from TK1 in channel B.

b. Connect the other end of the dc patch cord to the jack designated TK1 LINE IN in the channel A portion of the patch panel; this disconnects the teletype input from TK1 in channel A and connects it to TK1 in channel B.

3-25. To connect the dc output of a tone converter in channel B to an alternate output in channel A, proceed as follows:

a. Connect a dc patch cord to the jack designated TC1 LINE OUT in the channel A portion of the patch panel; this disconnects the output of TC1 in channel A from the output line.

b. Connect the other end of the dc patch cord to the jack designated TC1 EQUIP OUT in the channel B portion of the patch panel; this disconnects the output of TC1 from channel B and connects it to the channel A output line.

3-26. SPECIAL SIGNAL PATCHING. Under certain operating conditions it may be necessary

to connect two or more teletype circuits to a common input or output. These connections are made through special jacks on the patch panel. Teletype signals may be commoned by any one of three configurations: First, the dc teletype input signals may be connected to additional tone keyers as discussed in paragraph 3-27; secondly, the dc output of the tone converters may be connected to additional teleprinters as discussed in paragraph 3-28; thirdly, the composite audio input signal applied to a tone converter may be connected to an additional unit as discussed in paragraph 3-29.

3-27. To connect the dc signal received from a teletype transmitter assigned to channel A to more than one tone keyer, proceed as follows:

a. Connect a dc patch cord to the jack designated 1 LOOP in the auxiliary portion of the patch panel.

b. Connect the other end of the dc patch cord to the jack designated TK1 EQUIP IN in the channel B portion of the patch panel; this removes the normal input from TK1 in channel B.

c. Connect a dc patch cord to the jack designated 2 LOOP in the auxiliary portion of the patch panel.

d. Connect the other end of the dc patch cord to the jack designated TK1 EQUIP IN in the channel A portion of the patch panel; this removes the normal input from TK1 in channel A.

e. Connect a dc patch cord to the jack designated 3 LOOP in the auxiliary portion of the patch panel.

f. Connect the other end of the dc patch cord to the jack designated TK1 LINE IN in the channel A portion of the patch panel; this connects TC1 in channels A and B in series with the incoming teletype signal normally applied to channel A.

3-28. To connect the dc teleprinter signal generated by a tone converter in channel A to more than one teleprinter, proceed as follows:

a. Connect a dc patch cord to the jack designated 1 LOOP in the auxiliary portion of the patch panel.

b. Connect the other end of the dc patch

cord to the jack designated TC1 LINE OUT in the channel B portion of the patch panel; this disconnects the teleprinter assigned to TC1 in channel B from the output loop.

c. Connect a dc patch cord to the jack designated 2 LOOP in the auxiliary portion of the patch panel.

d. Connect the other end of the dc patch cord to the jack designated TC1 LINE OUT in the channel A portion of the patch panel; this disconnects the teleprinter assigned to TC1 in channel A from the output loop.

e. Connect a dc patch cord to the jack designated 3 LOOP in the auxiliary portion of the patch panel.

f. Connect the other end of the dc patch cord to the jack designated TC1 EQUIP OUT in the channel A portion of the patch panel; this connects the dc teleprinter output of TC1 in channel A in series with the teleprinter normally assigned to TC1 channel A and TC1 channel B.

3-29. To connect the composite audio signal applied to a tone converter in channel A to the input of an additional unit, proceed as follows:

NOTE

Tone converters to be connected in parallel must be tuned to a common center frequency.

a. Connect an audio patch cord to the jack designated TC1 EQUIP IN in the channel B portion of the patch panel; this removes the normal input from TC1 in channel B.

b. Connect the other end of the audio patch cord to a jack designated TONE MULT 1 in the auxiliary portion of the patch panel.

c. Connect an audio patch cord to a jack designated TONE MULT 1 in the auxiliary portion of the patch panel.

d. Connect the other end of the audio patch cord to the jack designated TC1 EQUIP IN in the channel A portion of the patch panel; this connects the inputs of TC1 in channel A and B in common.

e. Connect an audio patch cord to a jack designated TONE MULT 1 in the auxiliary portion of the patch panel.

f. Connect the other end of the audio patch cord to the jack designated TC MON in the channel A portion of the patch panel; this connects TC1 in channels A and B to the channel A multiplex input line.

3-30. MONITORING.

3-31. The patch panel in the VFTG group provides jacks for monitoring the various signals within the group. Audio signals may be monitored individually or collectively; in either case the equipment assignments and circuit connection are not altered. To monitor an audio signal, it is only necessary to connect an audio patch cord between the monitor and jack designated as MON corresponding to the signal to be observed.

3-32. The dc teletype and teleprinter signals are monitored similar to the audio signals ex-

cept that connecting a dc patch cord opens the loop circuit; therefore, before inserting a patch cord into a dc circuit, the other end of the patch cord must be connected to a series type monitor such as a current meter.

WARNING

Do not insert a dc patch cord in a dc monitor jack unless the other end is connected to a monitoring device. Lethal voltages are present on these jacks.

3-33. TURN OFF PROCEDURE.

3-34. The turn off procedures are the reverse of the turn on procedures.

SECTION III EMERGENCY OPERATION

NOT APPLICABLE

CHAPTER 4

PRINCIPLES OF OPERATION

4-1. **INTRODUCTION.** Information in this chapter will help you understand the electronic principles involved in the operation of the VFTG group. Section I presents the information you will need to understand the general operation of the VFTG group on a system level. Section II presents a functional description of the

individual plug-in subassemblies in the VFTG group. For a more comprehensive analysis of the individual units, refer to the appropriate technical manuals which are listed in the Introduction. Section III, Functional Operation of Mechanical Assemblies, is not applicable to this equipment.

SECTION I

FUNCTIONAL SYSTEM OPERATION

4-2. GENERAL DESCRIPTION.

4-3. The VFTG group functions as a 48 channel teletype multiplexer. Its output develops four composite audio signals for transmission over voice multiplex equipment. Each audio output contains the information for twelve teletype signals. The VFTG group also contains the equipment necessary to demultiplex four incoming composite audio signals, each of which contains the information for twelve teletype signals. The demultiplexers provide a dc teleprinter output to each subscriber.

4-4. Figure 4-1 shows the signal flow through the VFTG group for one teletype channel. The other channels function on the same order.

4-5. VFTG GROUP.

4-6. The VFTG group consists of the following major subassemblies which function together to provide the operating characteristics listed in table 1-2.

- (1) Tone keyers
- (2) Tone converters

- (3) Loop current control panel
- (4) Line battery supplies
- (5) Transistor power supplies
- (6) Patch panel
- (7) Volume and current level indicator

4-7. **SEND CIRCUITS.** The various teletype subscribers associated with the VFTG group are connected to the input send circuits by telephone-type land lines. Input lines are connected to a switching LINE IN jack on the patch panel. A normal-through switching configuration connects the input signal to an EQUIP IN jack corresponding to the tone keyer to which the subscriber is assigned. The equipment jack is connected to the input of the tone keyer.

4-8. The tone keyers transpose the dc teletype signals to audio tones which reflect the information contained in the teletype signal. These audio tones vary ± 42.5 cycles about a fixed center frequency (table 2-4). By operating each tone keyer on a different center frequency, spaced 170 cycles apart, the output of

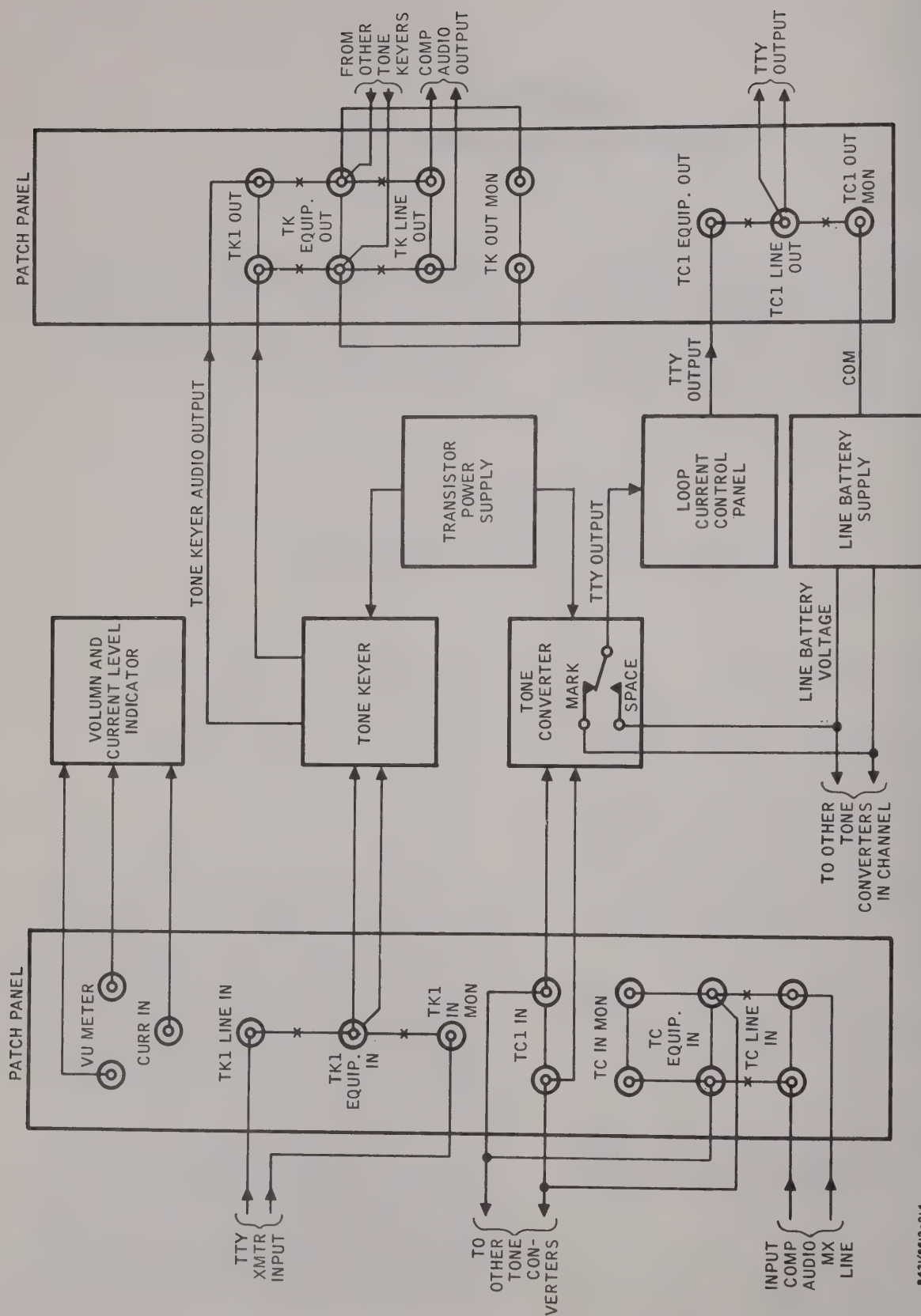


Figure 4-1. VFTG Group, Block Diagram

twelve units may be combined (multiplexed) and transmitted on a single voice frequency channel.

4-9. The audio output of each tone keyer is connected to TK OUT jacks on the patch panel which enable interception of an individual tone keyer output. A normal-through switching configuration connects the output signal to the combined output line. The common output is connected to an EQUIP OUT jack in which a normal-through switching configuration connects it to a LINE OUT jack. The output lines are connected to the line jacks.

4-10. RECEIVE CIRCUITS. Composite audio signals from the multiplex receivers are connected to the VFTG group by telephone-type land lines. Input lines are connected to a LINE IN jack on the patch panel. A normal-through switching configuration connects the input signal to and EQUIP IN jack which in turn is connected to the individual TC IN jacks. The jacks are connected directly to the tone converters.

4-11. The tone converters transpose incoming multiplexed audio signals to dc teleprinter signals. Four multiplexed signals are applied to the VFTG group, each of which contain twelve teletype audio signals. Each of the twelve incoming teletype audio signals deviate ± 42.5 cycles about fixed center frequencies spaced 170 cycles apart. The frequency to which the individual tone converters respond is set by a plug-in frequency determining network (table 2-4). The tone converters require external line battery supplies to provide teleprinter keying current.

4-12. The dc teleprinter output of each tone converter is connected to a current regulating resistor in the loop current control panel. By using a separate control for each teleprinter loop, they may be independently adjusted. The variable resistors are connected through a fuse to an EQUIP OUT jack on the patch panel. The dc output from the line battery supply is connected to a LINE OUT jack by the normal-

through switching of the jack field. The jack is connected to the teleprinter keying loop.

4-13. The line battery voltage required by the tone converters is provided by line battery supplies mounted on the power supply panel. Two line battery supplies are mounted on each power supply panel; one is operational and the other is maintained in a standby condition. The standby unit is automatically connected to the load in case of failure of the operational unit by a load transfer relay. When neutral keying is used, a positive voltage is applied to the mark contact of the output relay and the space contact is disconnected. However, if a polar keying output is required, a negative voltage is applied to the space contact.

4-14. The common returns of the supplies are connected to monitor jacks on the patch panel. Each monitor jack is connected in series with the teleprinter output line.

4-15. The operating voltage required by the tone keyers and tone converters is provided by two transistor power supplies mounted on the rear of each equipment shelf; each unit is capable of providing 14 vdc at a current of 450 milliamperes. One transistor power supply is operational and the other is maintained in a standby condition. The standby unit is automatically connected to the load in case of failure of the operational unit by a load transfer relay.

4-16. The volume and current level indicator in the VFTG group is a self-contained test set used to determine input and output signal levels. The indicator is capable of measuring audio signals between -60 and +29 dbm at frequencies between 30 and 17,000 cycles. The unit is also capable of measuring dc current from 0 to 75 milliamperes. Input signals may be applied to the volume and current level indicator through jacks on the patch panel (which, in turn, are connected to terminal strips on the rear of the chassis) or through jacks on the front of the unit.

SECTION II

FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

4-17. TONE KEYER.

4-18. GENERAL.

4-19. The frequency shift tone keyer utilizes transistors to perform the functions of switching, amplifying, and generating a center frequency. The keyed dc teletype input is amplified and applied to a variable phase network which causes the frequency of the tone generator to vary in accordance with the incoming signal. The output is applied to a common multiplex output line.

4-20. CIRCUIT DESCRIPTION.

4-21. The following discussion, in conjunction with the block diagram illustrated in figure 4-2, explains the basic principles of operation of the frequency shift tone keyers.

4-22. **KEYING INPUT.** The keyed dc signal received from the teletype transmitter is connected to a transistor keying amplifier. This amplifier permits acceptance of any keying method; however, the VFTG group employs 20/60 milliampere current keying from a grounded return negative input. When a negative voltage is applied to the input of the keying amplifier, it goes into steady conduction. The keying amplifier functions as a switch; that is, it goes from saturation (conduction) to cut off (nonconduction) on each input pulse. The output of the keying stage is applied to the constant amplitude variable phase circuit.

4-23. **CONSTANT AMPLITUDE VARIABLE PHASE CIRCUIT.** The constant amplitude variable phase circuit incorporated in the frequency shift tone keyer consists of a resistor-capaci-

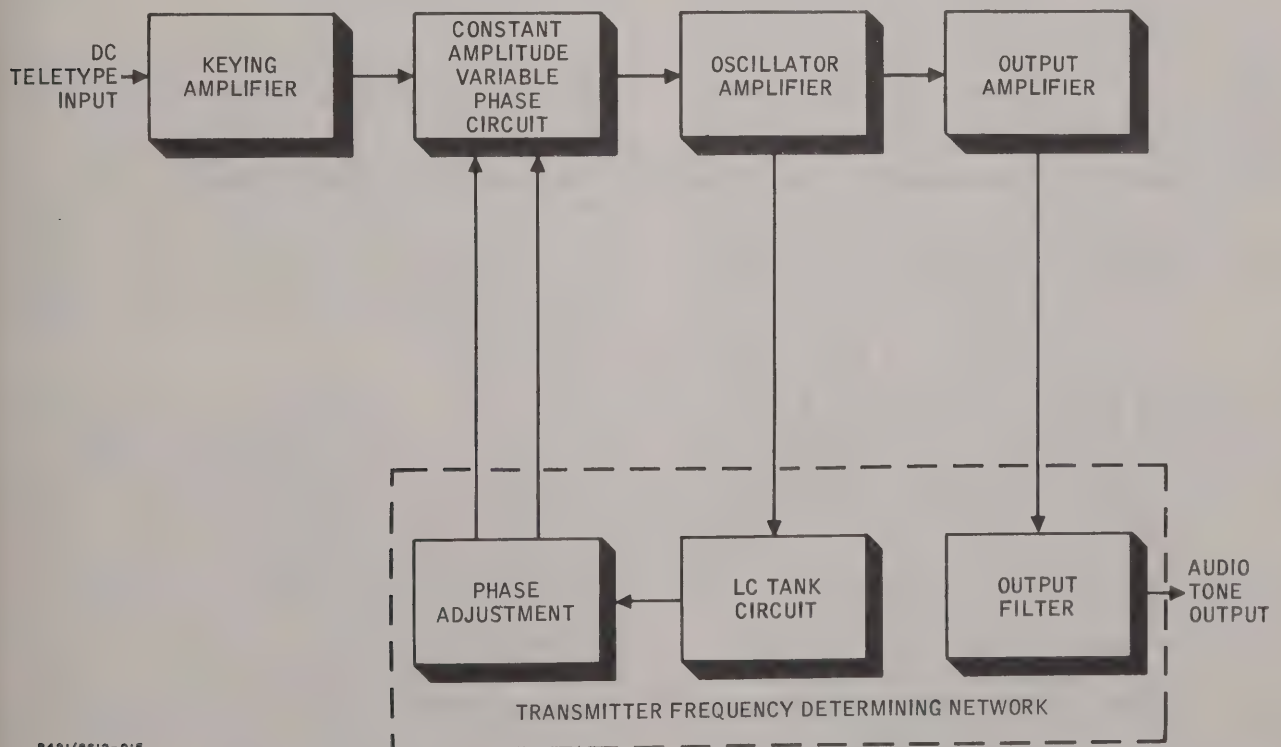


Figure 4-2. Tone Keyer, Block Diagram

tor (RC) network. This network is operated in conjunction with the inductor-capacitor (LC) tank circuit used to determine the operating frequency of the tone generator. The total resistance of the RC phase shifting network is a function of the conductance of the keying amplifier.

4-24. A portion of the resistance in the variable phase network is controlled by the phase adjustment circuit. This circuit consists of two variable resistors (MARK and SPACE controls) that enable precise regulation of the mark and space frequencies.

4-25. Varying the resistance in the phase shifting network does not effect the amplitude of the ac feedback within the oscillator stage. Therefore, this network is referred to as a constant amplitude variable phase circuit. The time required for the oscillator to shift frequency is not impaired by the normal capacitive lag due to the rapid response of the LC tank circuit.

4-26. OSCILLATOR-AMPLIFIER. The fundamental frequency of the oscillator is determined by an LC series resonant tank circuit. The phase shifting network is transformer coupled to the tank circuit at the junction of the inductor and capacitor. When the ratio of resistance to capacitance is varied in the phase shifting network, the variations are reflected in the LC tank circuit. These variations cause the current flowing through the phase shifting network to advance or retard, thereby causing the oscillator frequency to increase or decrease respectively. Because the frequency excursions are limited and symmetrical about the natural resonant frequency of the tank circuit, the output of the oscillator remains fairly constant.

4-27. The frequency shifted tone generated by the oscillator is applied to an amplifier stage. The amplifier presents a constant load to the oscillator which adds to the stability and increases the level of the signal. The output of the amplifier is applied to the output amplifier.

4-28. OUTPUT AMPLIFIER. The output stage of the frequency shift tone keyers is a straight class A amplifier used to couple the oscillator output to the channel filter. The filtered output is connected to a variable attenuator (located on the equipment shelf) which in turn is connected to the voice frequency multiplex circuit. The output impedance is 600 ohms which directly matches the characteristic impedance of the multiplex line.

4-29. TONE CONVERTER.

4-30. GENERAL.

4-31. The tone converter utilizes transistors to perform the functions of amplifying, limiting, and driving a mechanical output relay. The composite audio signal on the multiplex line is connected to a variable attenuator (mounted on the equipment shelf) which in turn is connected to the input amplifier through a selective filter. Signals within the bandpass of the filter are amplified and pass through a limiter stage to produce a square wave output. The square wave is coupled to a two coil discriminator which produces a full wave rectified dc signal. The rectified outputs are differentially combined and applied to a balanced dc amplifier. The balanced amplifier requires only a small portion of the input signal to produce full output. This configuration produces an output relatively free of distortion. The output of the dc amplifier is used to drive the mechanical output relay.

4-32. CIRCUIT DESCRIPTION.

4-33. The following discussion, in conjunction with the block diagram illustrated in figure 4-3, explains the basic principles of operation of the tone converters.

4-34. SELECTIVE FILTER INPUT. The composite audio tone received from the multiplex input line is connected to a selective frequency bandpass filter. The filter rejects noise, interference, and other undesired signals, but couples the desired input signal to the input ac amplifier. The filter is connected to only one side of the audio input; the other side of the input is grounded to the tone converter chassis. The filter output is developed across a center tapped winding.

4-35. INPUT AMPLIFIER. The input amplifier is a two transistor push-pull amplifier. The input to each amplifier is developed across the center tapped output winding of the selective filter. The amplifiers are connected together with diodes to produce a limiting action on large input signals. The push-pull output of the amplifiers is limited by a resistor and diode coupling circuit. The output limiter in turn is connected to the ac limiter stage; in addition, the output of the diode limiters may be commoned to additional tone converters for diversity operation.

4-36. AC LIMITER. The peak limited audio

signals are first applied to a conventional push-pull limiter. The output of the first limiter is applied to a controlled limiter. The combined gain of the input amplifier and two limiter stages is sufficient to provide adequate limiter action to signals as low as -60 db which are applied to the input of the tone converter. The push-pull output of the limiter is coupled to a discriminator.

4-37. DISCRIMINATOR. The square wave output of the ac limiter is applied to the two coil discriminator. This discriminator develops two full wave rectified dc outputs; using two outputs minimizes signal distortion. The two dc signals are differentially combined by a capacitor-resistor network. The resultant output is applied to a dc limiter amplifier.

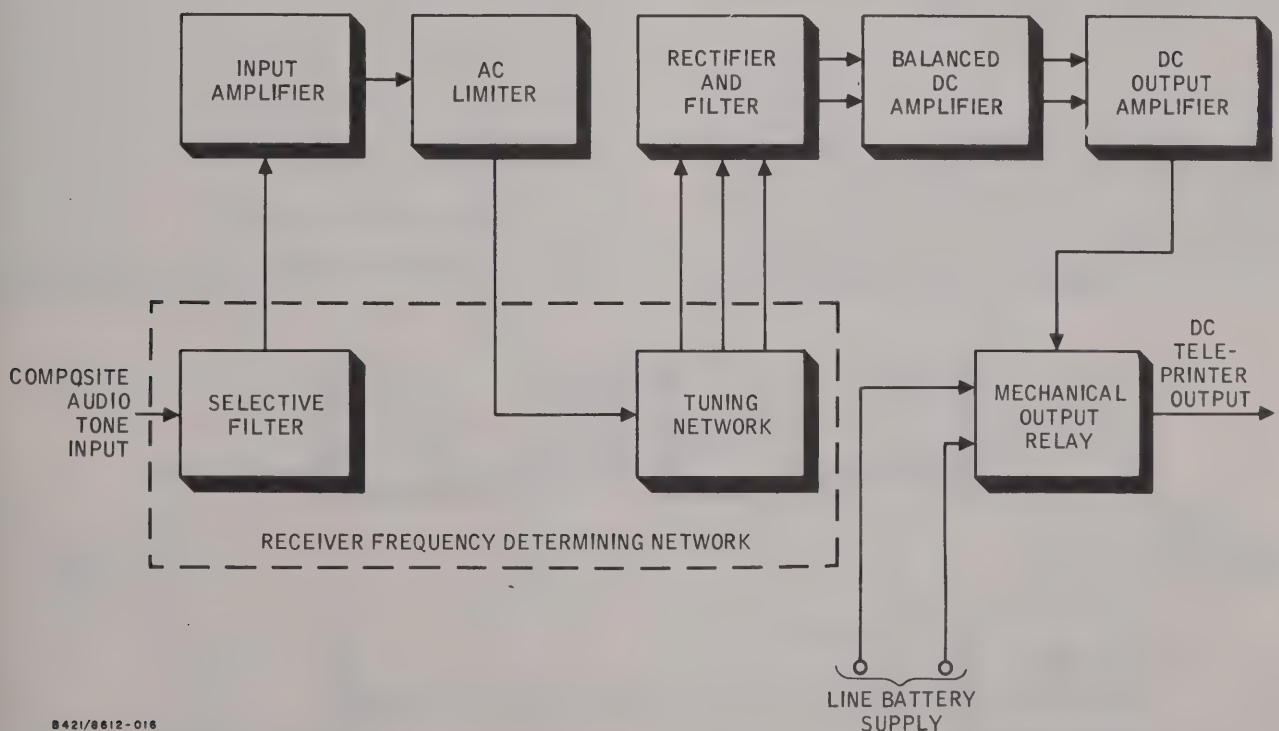
4-38. BALANCED DC AMPLIFIER. The resultant dc signal produced by the discriminator is applied to a balanced dc amplifier which requires only a small portion of the input signal to produce full output. This results in full mark or space output when the input audio tone signal deviates slightly from the center frequency corresponding to a mark or space shift. This arrangement minimizes the loading effect on the discriminator and produces equal output for either the mark or space signals. The out-

put of the balanced amplifier is applied to a push-pull dc amplifier.

4-39. DC OUTPUT AMPLIFIER. The output amplifier stage consists of two dc amplifiers operated in push-pull. The output of the amplifiers are connected to the relay socket and are open circuited until either a mechanical or transistor relay is connected to the socket.

4-40. MECHANICAL OUTPUT RELAY. The mechanical relay used in the tone converter is a plug in unit. The push-pull signal from the dc output amplifier is coupled to a push-pull transistor amplifier contained in the mechanical relay assembly. The relay has two coils each, which are connected to one of the transistors comprising the push-pull amplifier. When a mark signal is applied to the input of the tone converter the relay armature is pulled to one coil; a space signal causes the relay armature to pull the other coil. Thus, the frequency shifted audio tone has been converted to a mechanical movement.

4-41. Depending on the line battery power supply connections, the output relay can provide either a polar or neutral signal. To operate the tone converter in a polar keying circuit a positive voltage is applied to the contact



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Figure 4-3. Tone Converter, Block Diagram

which the armature touches in the space position; a negative voltage is applied to the contact which the armature touches in the mark position.

4-42. To operate the tone converter in a neutral keying circuit only a negative voltage need be connected to the contact which the armature touches in the mark position. The armature is connected to the teleprinter keying relay input.

4-43. LOOP CURRENT CONTROL PANEL.

4-44. GENERAL.

4-45. The loop current control panel utilizes resistors and indicator fuses to perform the function of regulating the current in the teleprinter keying loops and protect them from overload. This resistor and fuse configuration is connected in series with the tone converter dc teleprinter output and the teleprinter relay. The dc circuits are isolated from each other and, therefore, may be independently adjusted. The input and output of the loop current control panel is isolated from chassis ground.

4-46. CIRCUIT DESCRIPTION.

4-47. The following discussion, in conjunction with the schematic diagram illustrated in Chapter 6, explains the principles of operation of the loop current control shelf.

4-48. FUSE INDICATOR. The dc teleprinter keying signal received from each tone converter is connected to a fuse indicator (one per channel). The fuse indicator comprises a 1/8 ampere fuse which protects the loop circuit from overloads. In the event that the fuse blows, a neon indicator contained in the fuse cap will light. The indicator is connected in parallel with the fuse and remains shorted out until the fuse blows.

The output side of the fuse is connected to a variable resistor.

4-49. LOOP CURRENT CONTROL. The current in the teleprinter keying loop is adjustable by the variable resistor which is connected in series with each loop. The dc signal received from the output of each fuse indicator is connected to one side of a variable resistor. The sliding center tap is also connected to this junction; this configuration yields a variation between 0 and 2500 ohms. The output side of the variable resistor is connected to a fixed resistor which limits the loop current when the variable resistor is set to zero. The other end of the limiting resistor is connected to the teleprinter keying relay.

4-50. LINE BATTERY POWER SUPPLIES AND PANEL.

4-51. GENERAL.

4-52. The line battery power supplies utilize solid state components to develop the line battery voltage required by the tone converters. Two line battery power supplies are mounted on each line battery power supply panel. The ac input is applied to each line battery power supply wherein it is rectified. The dc outputs are connected to a load transfer switch which is used to manually connect one of the outputs to the load and keep the other output in standby. The load transfer switch is connected to a load transfer relay which automatically keeps the load connected to the operative line battery power supply. The output of the load transfer relay is connected to the tone converters to which the unit is assigned.

4-53. CIRCUIT DESCRIPTION.

4-54. The following discussion, in conjunction with the block diagram illustrated in figure 4-4,

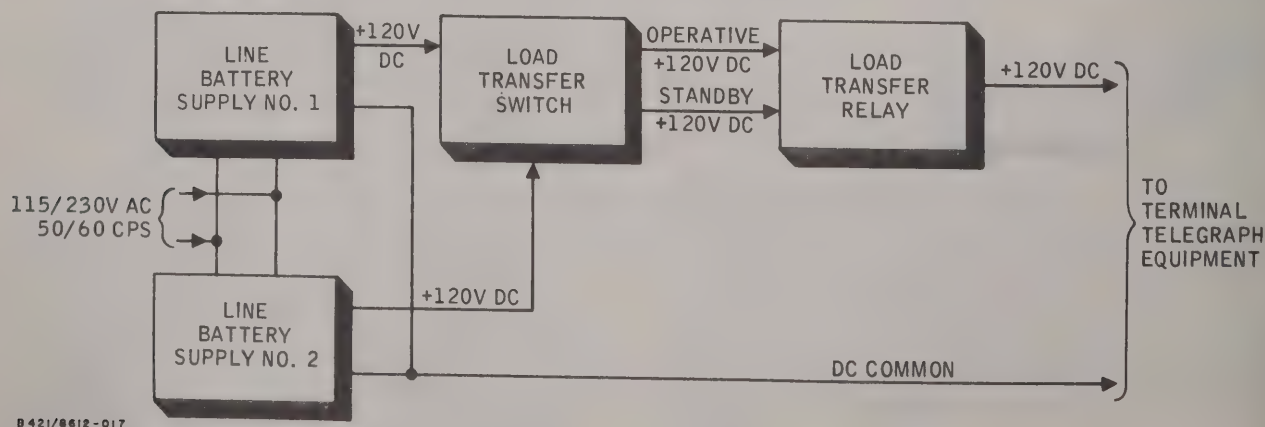


Figure 4-4. Power Supply Panel, Block Diagram

explains the basic principles of operation of the power supply panel and associated line battery supplies.

4-55. LINE BATTERY SUPPLIES. The ac line voltage of 115 or 230 volts (as determined by strapping) is applied to the line battery supplies, wherein it is applied to a transformer. The secondary of the transformer is center tapped for full wave operation; additional taps are provided to enable adjustment of the dc output voltage. The secondary windings are each connected to a solid state rectifier which produces a full wave rectified output voltage. The output voltage, which is isolated from chassis ground, is connected to a load transfer switch.

4-56. LOAD TRANSFER SWITCH. The dc output voltage of the two line battery power supplies is connected to alternate positions on the double-pole double-throw load transfer switch. Depending on the position of the switch, one dc output will be selected for connection to the load, and the other maintained in standby. The transfer terminals on the switch are connected to the load transfer relay.

4-57. LOAD TRANSFER RELAY. The dc output voltages, from the line battery supplies, are applied to the load transfer relay through the load transfer switch. The dc output selected by the load transfer switch is used to keep the load transfer relay energized. The output voltage is also connected to the relay contact which touches the armature in the energized position. The standby dc output voltage is connected to the relay contact which touches the armature when the relay is deenergized. Thus, when the relay is energized the dc output selected by the load transfer switch for connection to the load is connected. If that output fails, the relay deenergizes and connects the standby dc output to the load.

4-58. TRANSISTOR POWER SUPPLY.

4-59. GENERAL.

4-60. Transistor power supplies utilize transistors and solid state rectifiers to develop the operating voltage required by the tone keyers and tone converters. Two transistor power supplies are mounted on the rear of each equipment shelf. The ac input is applied to each transistor power supply wherein it is rectified and regulated. The dc outputs are connected to a load transfer switch which is used to manually select one of the outputs for connection to the load and maintain the other output in standby. The load transfer switch is connected to a load transfer relay which automatically keeps the load connected to the operative transistor power supply. The output of the load transfer relay is connected to the equipment shelf on which the unit is installed.

4-61. CIRCUIT DESCRIPTION.

4-62. The following discussion, in conjunction with the block diagram illustrated in figure 4-5, explains the basic principles of operation of the transistor power supplies.

4-63. TRANSISTOR POWER SUPPLIES. The ac line voltage of 115 or 230 vac (as determined by strapping) is applied to the transistor power supplies wherein it is applied to the transformer. The secondary of the transformer is connected across a bridge rectifier which produces a full wave output of 35 vdc. This dc output is applied to a diode shunted, current limiter stage. A filtered dc output voltage is 28 volts; an optional 28-volt unregulated output is taken from the filter capacitor. A reference voltage is established, by the diodes shunting the current limiter stage, which in turn is applied to a two

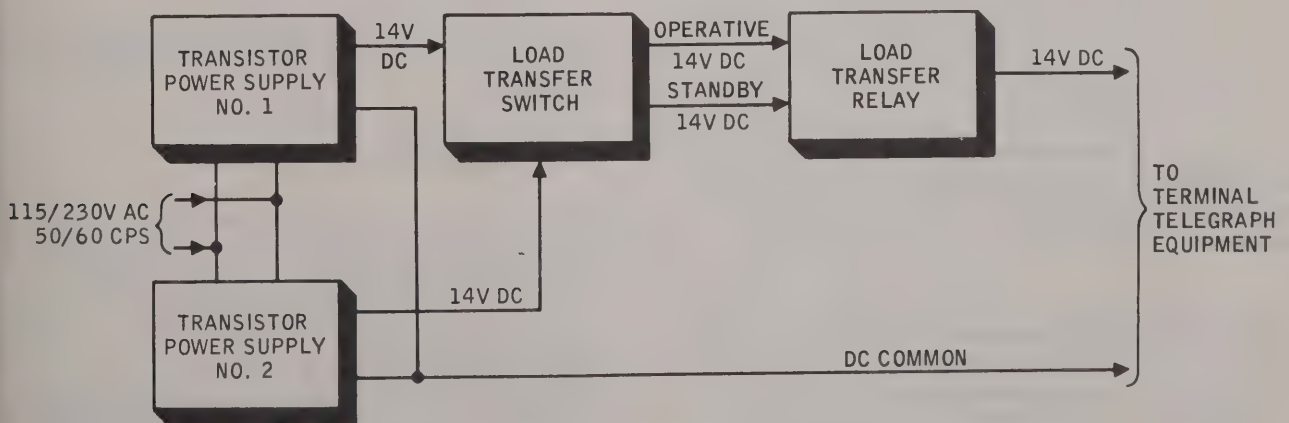


Figure 4-5. Transistor Power Supply, Block Diagram

stage series voltage regulator. The filtered dc output is also applied to the series regulator from which the dc output voltage is 13 volts and may be varied ± 1.5 volts. The regulated output voltage is isolated from common chassis ground and is connected to a load transfer circuit.

4-64. **LOAD TRANSFER CIRCUIT.** The dc output of the two transistor power supplies is connected to a load transfer switch and load transfer relay. The operation of the switch and relay is identical to the load transfer switch and load transfer relay on the line battery power supply panel; refer to paragraphs 4-56 and 4-57 respectively.

4-65. PATCH PANEL.

4-66. GENERAL.

4-67. The patch panel utilizes normal-through switching jacks to perform the functions of completing signal paths and connecting the tone keyers and tone converters to the input and output lines. These assignments are in effect unless altered by patching. Audio signals are transferred on double jacks to maintain isolation from ground, whereas dc teletype signals are transferred on single, common ground jacks.

4-68. CIRCUIT DESCRIPTION.

4-69. The following discussion, in conjunction with the cabling diagrams in Chapter 6, explains the operation of the patch panel jack field.

4-70. **INPUT JACKS.** Incoming multiplex signals lines are connected to the armature of the line jacks. The normal closed contact is in turn connected to the normal closed contact on the equipment jacks in which the armature is connected to the normal closed contact on the input jacks corresponding to each tone converter. The equipment jacks are shunted by monitor jacks. Connection to the monitor jacks does not alter the signal paths or equipment assignments established by the normal-through switching configuration.

4-71. Incoming dc teletype lines are each connected to the two armatures of a line jack. One normal closed contact of the line jack is connected to one of the normal closed contacts on an equipment jack in which the armature is connected to the input of a tone keyer. The re-

maining normal closed contact on the line jack is connected to the remaining normal closed contact on the equipment jack in which the armature is connected to the armature of a monitor jack. The normal closed contact of the monitor jack is connected to the common input terminal on the tone keyer. Connecting a patch cord to the dc monitor jacks opens a series circuit thereby interrupting the signal path; therefore, a series type monitor must be used to complete the circuit.

4-72. **OUTPUT JACKS.** The audio outputs of the tone keyers are connected to the armatures of output jacks in which the normal closed contacts are connected to common multiplex lines. The multiplex lines are connected to the armatures of an equipment jack in which the normal closed contacts are connected to the normal closed contacts on a line jack. The armature of the line jack is connected to an output multiplex line. The equipment jacks are shunted by monitor jacks. Connection to the monitor jack does not alter the signal paths or equipment assignments established by the normal-through switching configuration.

4-73. The dc teleprinter outputs of tone converters are connected through the loop current control shelf to one armature on an equipment jack in which the corresponding normal closed contact is connected to a normal closed contact on a line jack; the line jack armatures are connected to an armature on a monitor jack in which normal closed contact is connected to the teleprinter keying loop. The line battery supply common line is connected to an armature on the equipment jacks and the corresponding normal closed contact is connected to a normal closed contact on a line jack. Connecting a patch cord to the dc monitor jacks opens a series circuit thereby interrupting the signal path; therefore, a series type monitor must be used to complete the circuit.

4-74. VOLUME AND CURRENT LEVEL INDICATOR.

4-75. GENERAL.

4-76. The volume and current level indicator utilizes vacuum tubes to perform the functions of amplifying and rectifying audio signals applied to the unit for measurement. Audio signals to be measured are applied to an impedance matching and calibrated attenuator network. The output of the attenuator is amplified and applied to a cathode follower. The cathode follower in turn drives the VU meter. Current

measurements are made by a ± 75 milliampere center scale meter. The dc signals are connected directly to the current meter. Operating power for the volume and current level indicator is supplied by a self-contained, regulated power supply.

4-77. CIRCUIT DESCRIPTION.

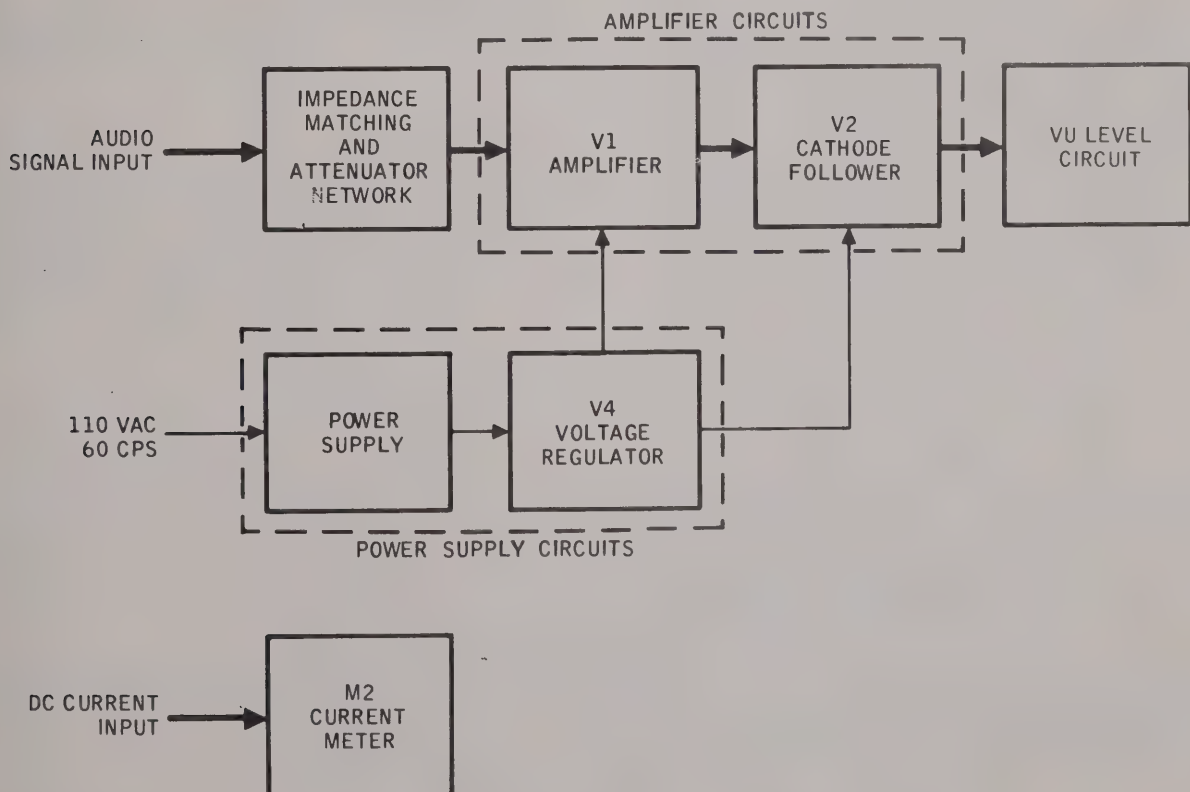
4-78. The following discussion, in conjunction with the block diagram illustrated in figure 4-6, explains the basic principles of operation of the volume and current level indicator.

4-79. **IMPEDANCE MATCHING AND ATTENUATION NETWORK.** Incoming audio signals are applied to an impedance matching transformer. The transformer primary is shunted by a switch which enables connection of 600 ohms termination to the input. With the shunt removed, the input is established by bridging. The secondary of the impedance matching transformer is connected to a variable resistor with one side grounded to chassis. The center tap of the variable resistor is connected to the amplifier input grid. The degree of attenuation is determined by the position of the center tap; the position is calibrated between -60 and +29 db.

4-80. **INPUT AMPLIFIER.** The audio signal developed across the attenuator resistor is applied to one-half a twin triode amplifier. The output of this first stage is capacitively coupled to a variable resistor with one side grounded. The center tap of the variable resistor is connected to the input grid of the second half of the twin triode amplifier. This variable resistor functions as a zero adjustment on the VU meter. The amplified signal is capacitively coupled to the input grid of the cathode follower stage.

4-81. **CATHODE FOLLOWER.** The amplified audio signals are applied to the input grid of the cathode follower stage. The cathode output is connected to a thermal relay which, in turn, is connected to the VU meter through a parallel resistor and capacitor network. The thermal relay shunts the VU meter to ground during transient changing of the coupling capacitor.

4-82. **CURRENT METER.** The current in the various teletype loops is measured by a center scale dc milliampere meter; the meter must be connected in series with the loop to be measured. Input signals are connected directly to the meter.



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Figure 4-6. Volume and Current Level Indicator, Block Diagram

4-83. POWER SUPPLY. The ac line voltage of 115 or 230 volts (as determined by strapping) is applied to a transformer. The transformer provides filament and plate voltage. The high voltage secondary winding is center tapped and the tap is connected to chassis

ground. The secondary windings are connected to a full wave rectifier. The dc output of the rectifier is filtered and applied to a voltage regulator tube. The regulated output is applied to the anodes of the amplifiers and cathode followers.

CHAPTER 5
MAINTENANCE

5-1. INTRODUCTION. This chapter contains instructions you will need to maintain the VFTG group in top condition. Section I gives you the organizational/field level maintenance procedures.

Also included in Section I are performance tests, alignment procedures, and removal replacement procedures for the equipment. Section II, Special Maintenance, is not applicable.

SECTION I
ORGANIZATIONAL/FIELD MAINTENANCE

5-2. GENERAL.

5-3. This section provides instructions, on an equipment level, using the test equipment listed in tables 1-3 and 1-4.

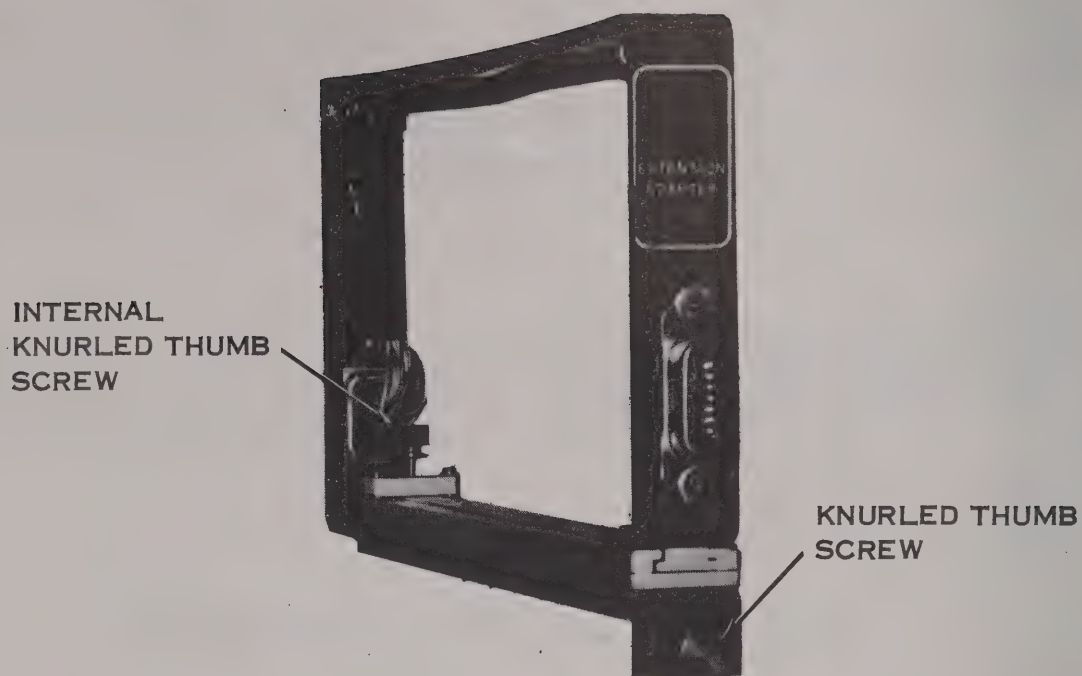
In performing organizational/field maintenance according to the instructions, reference should be made to the schematics contained in Chapter 6 of this manual and the individual equipment manuals. (Refer to Appendix A.)

5-4. TEST EQUIPMENT.

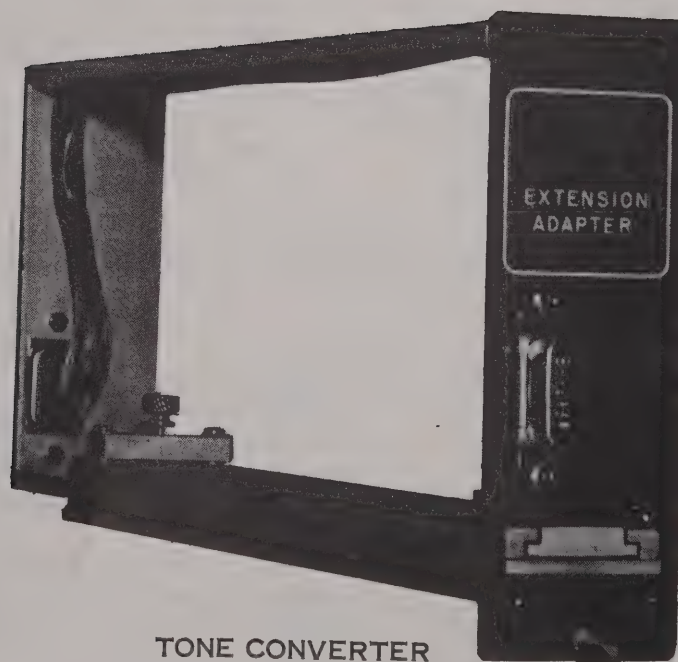
5-5. The test equipment required for organizational/field maintenance is listed in table 5-1. The test equipment operating characteristics given in table 5-1 are those which are applicable to the testing of the VFTG group, and do not necessarily represent the maximum capabilities of the test equipment. The extension adapters shown in figure 5-1 provide a convenient method for testing the tone keys and tone converters without interrupting operation of the VFTG group.

Table 5-1. Test Equipment Required for Organizational/Field Maintenance

<u>Test Equipment</u>	<u>Characteristics</u>
Test Oscillator (Hewlett-Packard 650A)	Frequency Range: 10 cps to 10 mc; Power Range: -60 to +29 dbm; Output Impedance: 600Ω balanced
VTVM (ME-26A/U).....	AC voltage range: to 30 v (full scale) Input Impedance: 10 megohms Frequency Response: 20 cps to 40 kc Accuracy: ±3%
Oscilloscope (Tektronix 503).....	Sensitivity Vertical: 0.01 vrms/in. , minimum Sensitivity Horizontal: 0.1 vrms/in. , minimum Frequency Response, Horizontal and Vertical: dc to 40 kc Input Impedance: 1 megohm Sweep Speed: 2 cps to 4 kc



TONE KEYER



TONE CONVERTER

Figure 5-1. Extension Adapters

Table 5-1. Test Equipment Required for Organizational/Field Maintenance (cont)

Test EquipmentCharacteristics

Generator, Signal SG-605A/MRM-9 (TDMS transmitter)	Test Signal: 1:1, 2:2, 6:1 and 1:6 reversals, and signal character or 100 character test message transmitted at modulation rates of 30, 50, 70, or 90 bauds with adjustable start element distortion from 1 to 50% contact closure output: used in conjunction with rack mounted power supply
Fault Locator, Transmission Line TS-2146A/MRM-9 (TDMS receiver)	Signal Analysis: Synchronous and start-stop signals to 4 to 14 elements with modulation rate of 20 to 100 bauds; low (current input) or high (voltage input) impedance; polar or neutral, positive or negative input signals; visual presentation of percent distortion; used in conjunction with oscilloscope
Relay Test Adapter (Radiation, Inc. 14-1-1).	Polar Relay Test: Test jig for test of octal-based polar relay; internal test signal generator with modulation rate up to 100 bauds; visual presentation of percent distortion; contact bounce and contact transit time.
Power Supply PP-4169A/MRM-9.....	Voltage Output: +450 (reg.), +260 (reg), -150 (reg), -800 (reg), 6.3 vac -60 cycles
Multimeter, AN/PSM-6.....	Range: 0-250 vdc

5-6. PERFORMANCE STANDARDS.

5-7. The performance standards for signal level and frequency do not appear in this manual. However, performance tests are based on equipment aligned and adjusted in accordance with the instructions given in paragraphs 5-25 through 5-43. These standards are supplemented by the telegraph distortion measurement procedures described in paragraphs 5-44 through 5-55. Refer to the alignment procedures in this section to correct any abnormal conditions.

5-8. TEST POINTS.

5-9. The VFTG group is provided with test jacks to aid the technician in aligning and maintaining the equipment. Table 3-7 lists the test jacks, their location, and function. The test jacks on the tone keyers and tone converters are shown in figure 3-1. Test jacks which are not front panel mounted are shown in figure 3-2.

5-10. DC VOLTAGE REQUIREMENTS AND SOURCES.

5-11. Table 5-2 lists the dc operating voltages required by the equipments in the VFTG group.

5-12. PREVENTIVE MAINTENANCE.

5-13. Routine maintenance procedures designed to detect and help prevent troubles before equipment operation is seriously impaired are not contained in this manual.

Table 5-2. DC Voltage Requirements and Sources

Equipment	DC Operating Voltage	Source
Tone keyer	14v (regulated)	Transistor Power Supply
Tone converter	14v (regulated)	Transistor Power Supply
Tone converter	120/60v	Line Battery Supplies

5-14. IDENTIFICATION OF PARTS.

5-15. Figure 5-2 identifies, by reference designations, the unmarked electronic components mounted on the patch panel.

5-16. SUBASSEMBLY REMOVAL AND REPLACEMENT.5-17. GENERAL.

5-18. When removal or replacement of sub-

assemblies is required, refer to the applicable assembly breakdown illustrations in Chapter 7 along with the removal and installation procedures in Chapter 2 of this manual. The subassemblies contained in the VFTG group may be extended beyond the equipment rack for performance of maintenance.

CAUTION

Do not extend more than three equipment shelves or panels at the same time unless the equipment rack is bolted to the floor.

5-19. EQUIPMENT SHELF EXTENSION.

5-20. The equipment shelves may be extended for maintenance without interrupting the operation of the plug-in units. When the equipment shelf is fully extended, it may be incrementally rotated up to 180 degrees to provide better accessibility to the rear of the unit. To extend the equipment shelves, proceed as follows (fig. 5-3):

CAUTION

Prior to extending an equipment insure that the tone keyers and tone converters are secured to the equipment shelf.

- a. Loosen the four knurled thumbscrews securing the equipment shelf to the equipment.
- b. Pull the equipment shelf forward until the slide latches engage; if the equipment shelf does not extend freely it may be necessary to partially extend the adjacent equipment shelves.
- c. To fully extend the equipment shelf, press down on the slide release and pull the equipment shelf forward until the slide latch engages.

CAUTION

Firmly grasp the sides of the equipment shelf before releasing the shelf pivot latches.

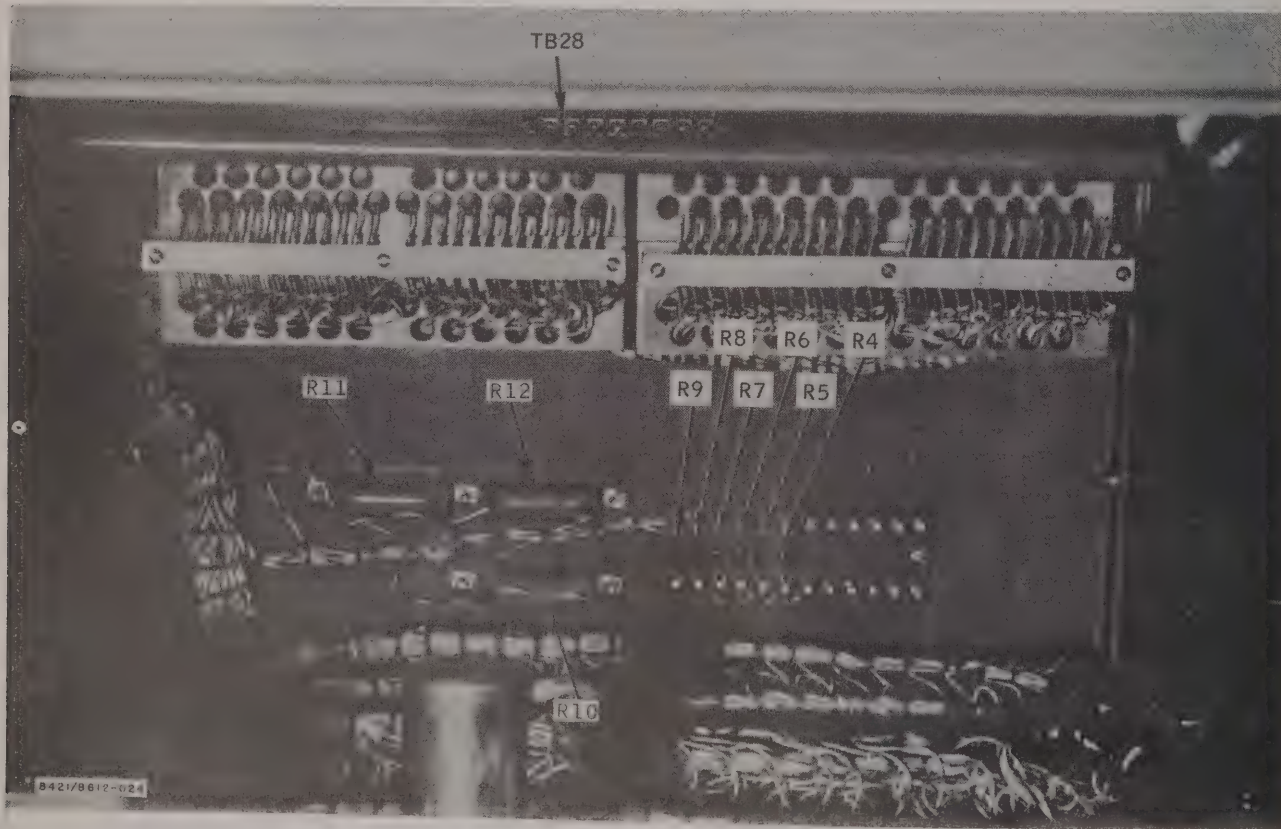


Figure 5-2. Patch Panel, Component Identification

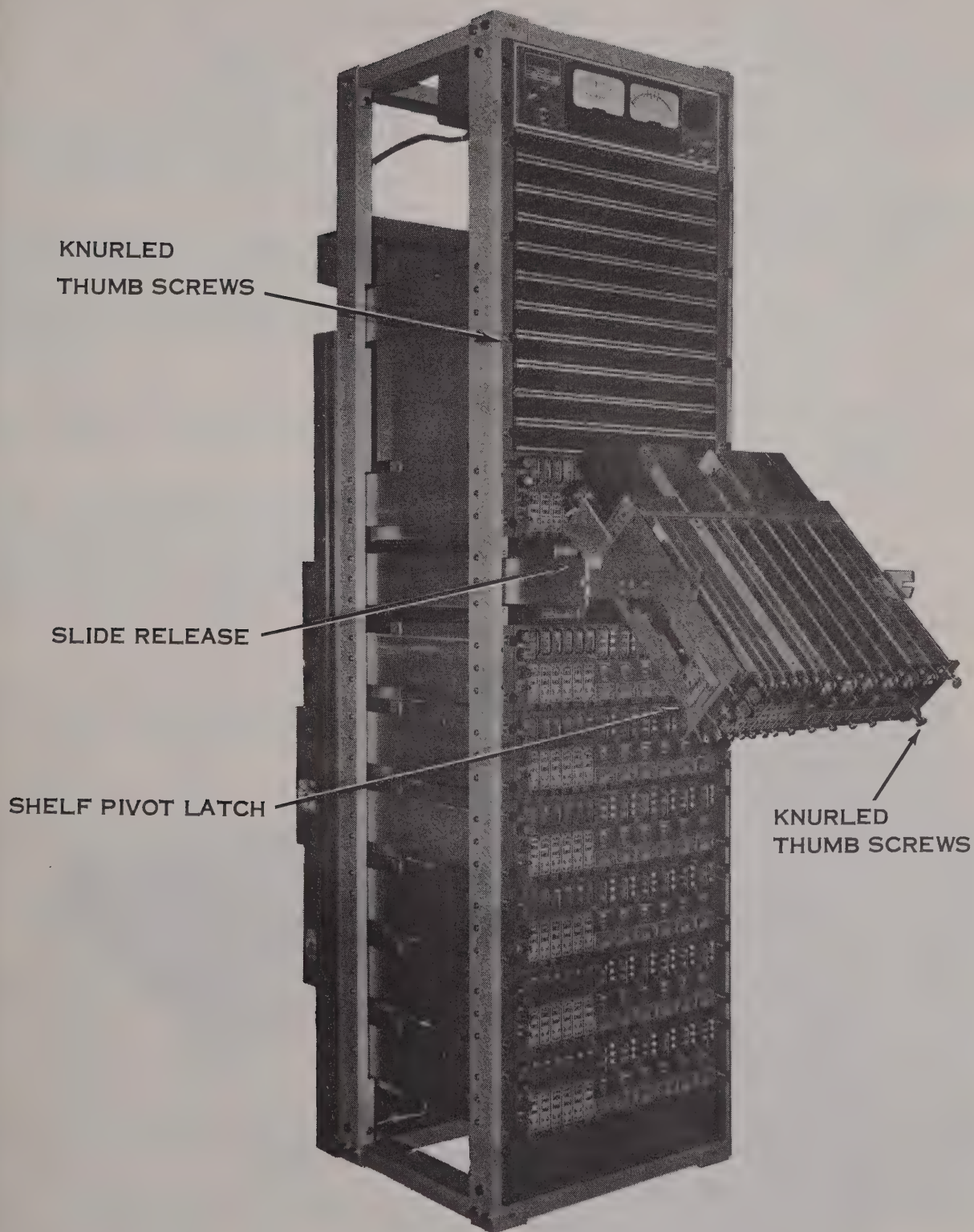


Figure 5-3. Equipment Shelf, Extended

d. To rotate the equipment shelf pull forward on each shelf pivot latch; rotate to desired angle and release shelf pivot latch; if the latch does not properly engage in the detent, rotate the equipment shelf about this position.

5-21. POWER SUPPLY PANEL EXTENSION.

5-22. The power supply panel and associated line battery supplies may be extended for maintenance without interrupting the operation of the unit. To extend the power supply panels, proceed as follows (fig. 5-4):

a. Loosen the two knurled thumbscrews securing the power supply panel to the equipment rack.

b. Using the knurled thumbscrews, pull forward on the power supply panel until the slide latches engage; if the panel does not extend freely, it may be necessary to partially extend the adjacent units.

5-23. PATCH PANEL EXTENSION.

5-24. The patch panel may be extended for maintenance without interrupting the operation

of the VFTG group. To extend the patch panel, proceed as follows (fig. 5-3):

CAUTION

If the patch panel does not extend freely, do not use excessive force as this would result in damage to the cabling.

a. Loosen the eight knurled thumbscrews securing the patch panel to the equipment rack.

b. Using the knurled thumbscrews, pull forward on the patch panel until the slide latches engage.

5-25. ALIGNMENT AND ADJUSTMENT.

5-26. GENERAL.

5-27. The procedures contained herein will enable you to perform all postinstallation adjustments and alignments necessary to maintain the VFTG group operating properly. These procedures should be performed after repair or replacement of a tone keyer or tone conver-

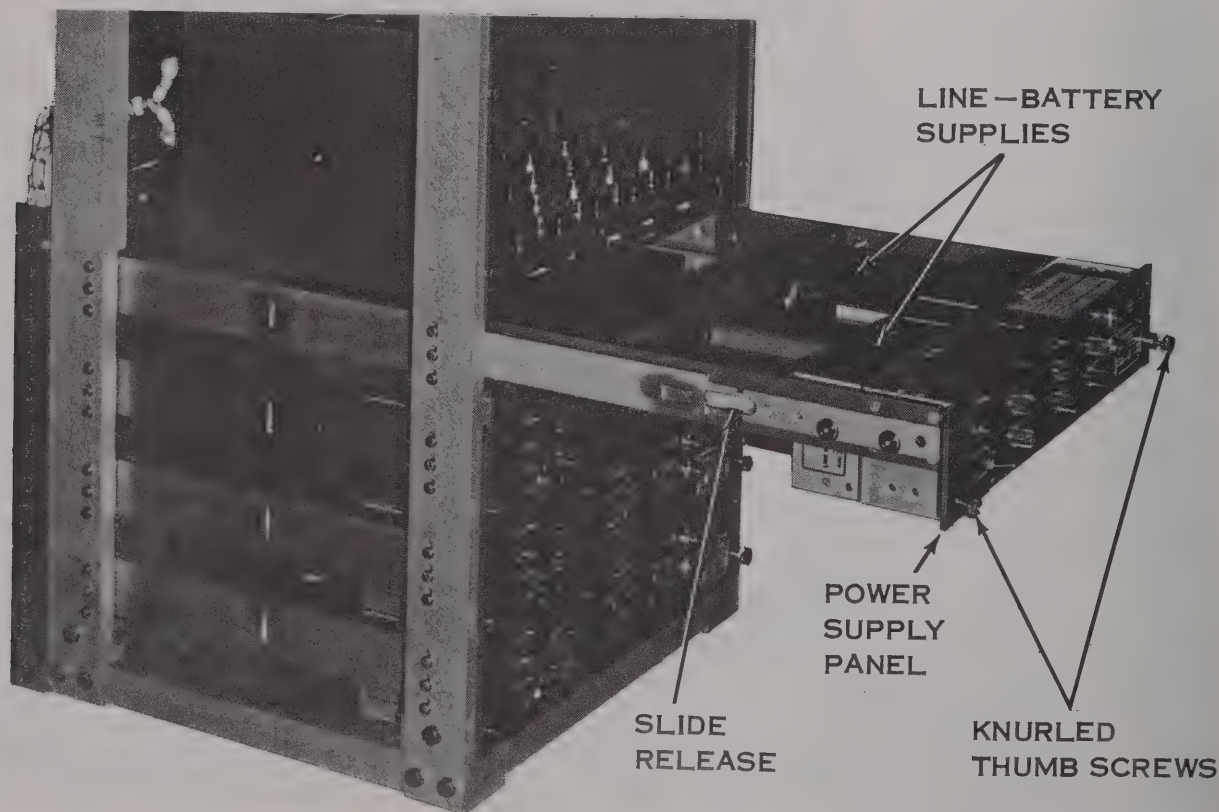


Figure 5-4. Power Supply Panel, Extended

ter, after the equipment has been turned off for a long period of time, or when deemed necessary by the station supervisor.

5-28. It is assumed that the equipments comprised in the VFTG group have been properly installed in accordance with the applicable installation instructions in Chapter 2 and applicable wiring diagrams in Chapter 6 of this manual; that the external signal connections have been extended to the installation dc and voice frequency determining networks and mechanical relays have been aligned and/or adjusted prior to installation; that the ac power is applied to the VFTG group and that the POWER switch on each equipment shelf is in the on (up) position.

5-29. CALIBRATION OF VOLUME AND CURRENT LEVEL INDICATOR.

5-30. Prior to aligning the tone keyers and tone converters the volume and current level indicator installed in the VFTG group must be checked for accuracy. The indicator is calibrated in accordance with the following procedure:

- a. Set POWER switch on the front panel of the volume and current level indicator to off position and remove any patch cords which may be connected to the VU METER jack on the patch panel.
- b. Using a small screwdriver, mechanically zero the current and VU meter by means of the screw adjustment on each meter.
- c. Set POWER switch on the volume and current level indicator to the on position.
- d. Set TERMINATING INPUT-BRIDGING INPUT switch to TERMINATING INPUT position.
- e. Set attenuator control to 0 db.
- f. Connect test oscillator (Hewlett-Packard 650A) to jacks designated VU METER on the auxiliary portion of the patch panel.
- g. Set the test oscillator to a frequency of 1000 cycles at an output level of 0 dbm.
- h. Using a screwdriver, rotate the ZERO ADJUST control on the front panel of the volume and current level indicator until the VU meter indicates 0.

5-31. TRANSISTOR POWER SUPPLY OUTPUT VOLTAGE ADJUSTMENT.

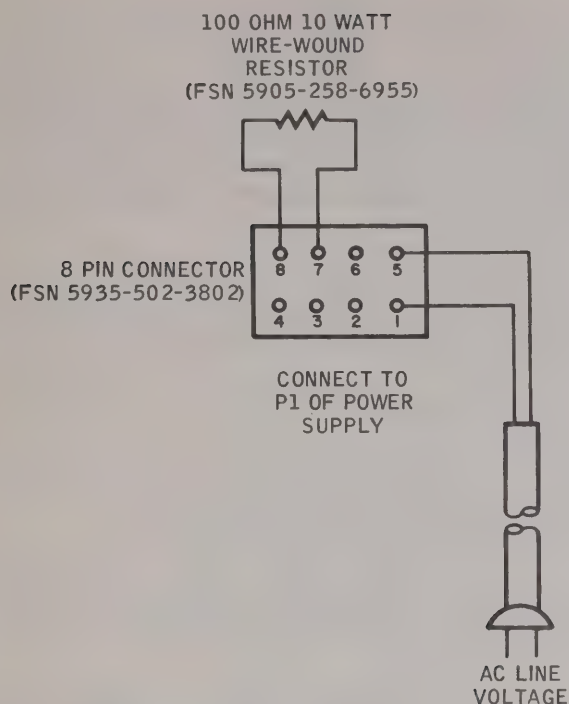
5-32. The output voltage of the two transistor power supplies mounted on the rear of the equipment shelves must be adjusted within prescribed limits in accordance with the following procedure:

- a. Fully extend and rotate the equipment shelf on which the transistor power supplies are to be adjusted; refer to paragraph 5-19.
- b. Set the VTVM (ME-26A/U) to indicate 30 vdc.
- c. Connect the positive lead on the VTVM to test point J2 on the chassis of transistor power supply to be adjusted (fig. 3-2).
- d. Connect the negative lead of the VTVM to test point J1; the voltage indicated should be 14 vdc ± 1.5 volts.
- e. If the voltage indicated is not within the prescribed limits disconnect the VTVM and set the equipment shelf POWER switch to the off position and remove the transistor power supply.
- f. Construct the power supply test jig illustrated in figure 5-5 and connect it to plug P1 on transistor power supply.

WARNING

Lethal voltages exist at the exposed cable connector terminals and at various points in the transistor power supply. Use extreme care in making readings. Insure that the test cable plug is inserted in the power supply receptacle prior to connecting to the ac line and that the test cable is removed from the ac line prior to removing the cable.

- g. Connect the positive lead of the VTVM to jack J2 on the transistor power supply.
- h. Connect the negative lead to jack J1.
- i. Connect the test cable to the ac line.
- j. Adjust resistor R5 on the transistor power supply until the VTVM indicates 14 vdc (fig. 5-6).



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Figure 5-5. Power Supply Test Cable, Field Fabricated

k. Remove the test cable from the ac line and remove it from plug P1.

l. Remove the test cable from the ac line and remove it from plug P1.

5-33. TONE KEYSER FREQUENCY ADJUSTMENT.

5-34. Precise adjustment of the mark and

space frequencies generated by the tone keyers is essential for proper operation of the VFTG group. Checking and adjustment of these frequencies is required following initial installation and periodically thereafter. Although these adjustments may be accomplished while the VFTG group is in operation, the individual tone keyer being adjusted must be removed from service. The mark and space frequencies are identified on the individual tone keyers.

5-35. To adjust the mark and space frequencies generated by the tone keyers, proceed as follows:

NOTE

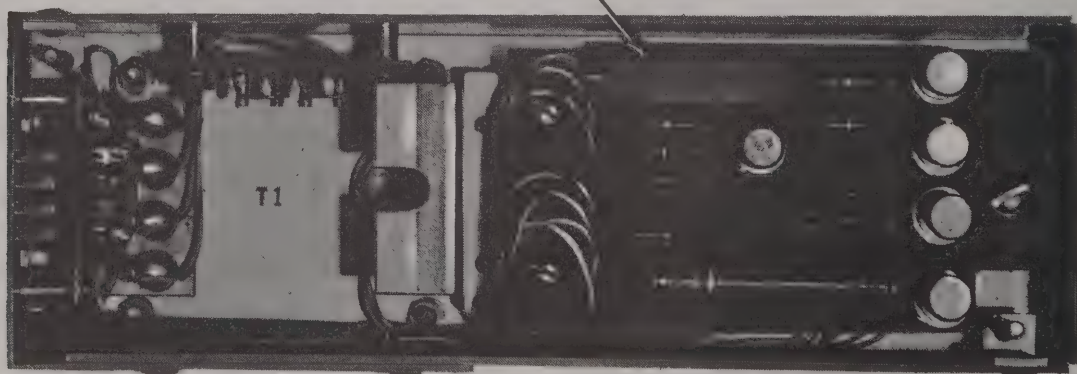
The mark frequency should always be adjusted first because it will affect the space frequency. The space frequency control should have no effect on the mark frequency.

a. Request that one of the teletype subscribers associated with the VFTG group transmit a steady mark signal (60 ma neutral, 20 ma polar) and that a second subscriber transmit a steady space signal (0 ma neutral, 20 ma polar).

b. Insert a dc patch cord in the patch panel jack designated TK EQUIP IN corresponding to the tone keyer to be adjusted.

c. Connect the other end of the patch cord to the jack designated TK LINE IN corresponding to the subscriber transmitting the mark signal.

VOLTAGE ADJUSTMENT RESISTOR R5



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Figure 5-6. Transistor Power Supply, Bottom View

d. Connect the oscilloscope to jacks J2 and J3 on the tone keyer (fig. 5-7); a sine wave audio signal of approximately the mark frequency should be observed.

e. Remove the oscilloscope leads from jacks J2 and J3 on the tone keyer.

f. Connect the frequency counter to jacks J2 and J3 on the tone keyers; the counter should indicate the mark frequency.

g. Using a small screwdriver, adjust MARK control R102 for an indication on the frequency counter of the mark frequency ± 1 cycle (fig. 5-7).

h. Remove the dc patch cord from the mark signal TK LINE IN jack and connect it to the LINE IN jack corresponding to the subscriber transmitting the space signal.

i. Using a small screwdriver, adjust SPACE control R103 (fig. 5-7) for an indication on the frequency counter of the space frequency ± 1 cycle.

j. Move the dc patch cord back to the jack providing the mark signal. If the frequency counter does not indicate the proper mark frequency, ± 1 cycle, readjust MARK control R102.

k. Disconnect the frequency counter from the tone keyer.

l. Remove the dc patch cord from the tele-type TK LINE IN jack.

m. Remove the other end of the dc patch cord from the TK EQUIP IN jack.

5-36. TONE KEYER LEVEL ADJUSTMENT.

5-37. The audio output of each tone keyer, within a given channel, must be adjusted to a specific level. When each tone keyer is adjusted, the composite audio output of the entire channel must be adjusted to provide the proper output level. The output level of each tone keyer is adjusted in accordance with the procedure described in paragraph 5-38. The composite audio output level of each group of 12

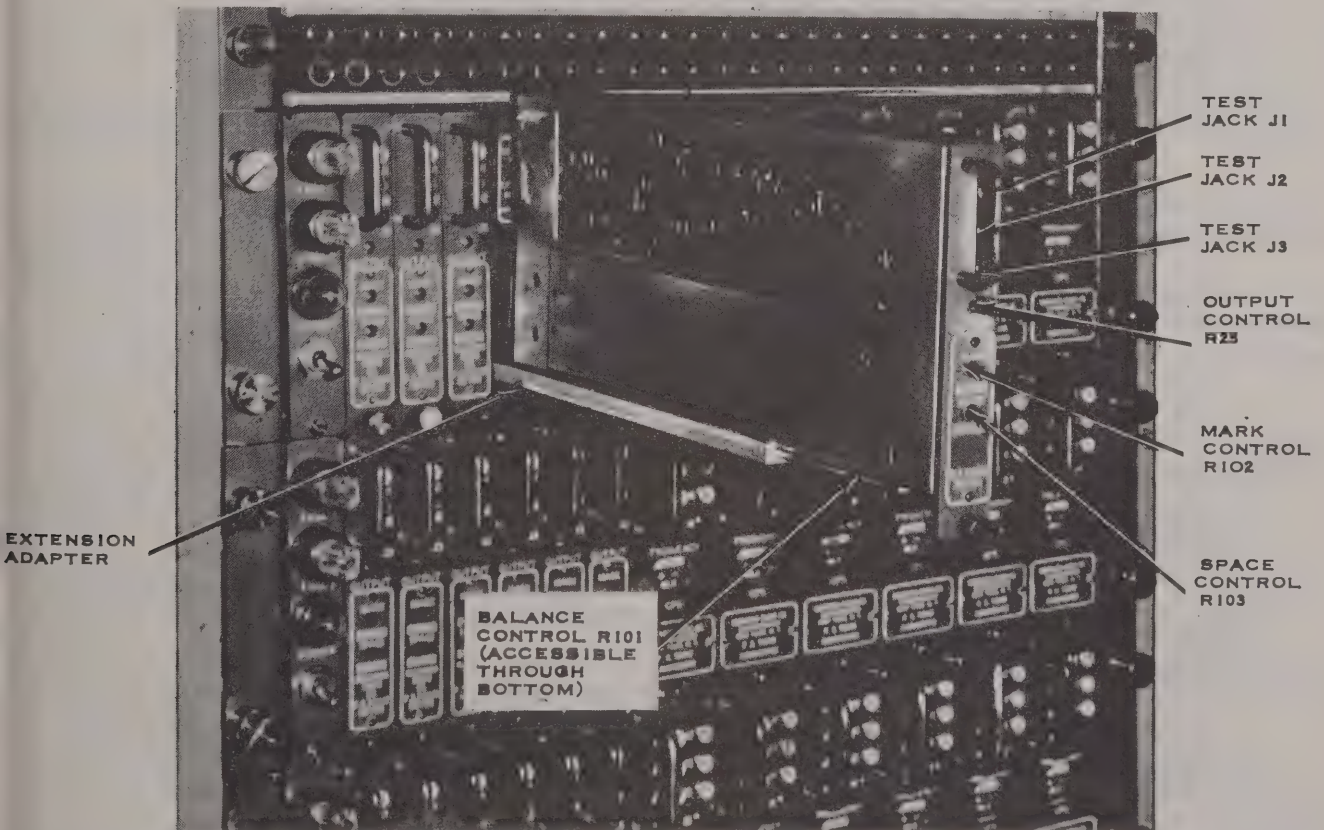


Figure 5-7. Tone Keyer with Extension Adapter Installed

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tone keyers is adjusted in accordance with the procedure described in paragraph 5-39.

5-38. INDIVIDUAL TONE KEYER ADJUSTMENTS. To adjust the output level of each tone keyer, proceed as follows:

a. Loosen the internal knurled thumbscrew on the tone keyer extension adapter (fig. 5-1) and extend the slide through the front panel of the adapter and retighten the thumbscrew.

b. Remove the tone keyer to be adjusted from the equipment shelf.

c. Install the tone keyer extension adapter in the vacant space in the equipment shelf (fig. 5-7), and secure in place by tightening the knurled thumbscrew on the bottom of the adapter.

d. Install the tone keyer on the extension adapter by engaging the bottom slide of the adapter and sliding forward until the plug on the rear of the tone keyer engages the receptacle on the adapter.

e. Request that one of the teletype subscribers associated with the VFTG group transmit a steady mark signal (60 ma neutral, 20 ma polar) and that a second subscriber transmit a steady space signal (0 ma neutral, 20 ma polar).

f. Set the attenuator control on the volume and current level indicator to 0 VU.

g. Set the BRIDGING INPUT-TERMINATING INPUT switch to the TERMINATING INPUT position.

h. Connect an audio patch cord to the jack designated VU METER on the auxiliary portion of the patch panel.

i. Connect the other end of the audio patch cord to the TK OUT jack corresponding to the tone keyer being adjusted.

j. Connect a dc patch cord to the TK EQUIP IN jack corresponding to the tone keyer being adjusted.

k. Connect the other end of the dc patch cord to the LINE jack corresponding to the subscriber transmitting the steady mark signal.

l. Using a small screwdriver, adjust

OUTPUT control R25 (fig. 5-7) for an indication of 0 VU on the vu meter.

m. Remove the dc patch cord from the LINE jack on which the mark signal is present and connect it to the LINE jack corresponding to the subscriber transmitting the steady space signal.

NOTE

The output level for the mark and space signals should not differ more than 1 vu.

n. Set the vacuum tube voltmeter (VTVM) to the 1 vac range and connect to jacks J2 and J3 on the tone keyer (fig. 5-7).

o. Alternate the dc patch cord between the steady mark and steady space LINE jacks.

p. Using a small screwdriver, adjust balance control R101 on the bottom of the tone keyer until the VTVM indicates an equal voltage for both mark and space inputs; average readings will be about 0.775 vac.

q. Remove the VTVM leads from jacks J2 and J3.

r. Remove the dc patch cord from the teletype subscriber LINE jack.

s. Remove the other end of the dc patch cord from the TK EQUIP IN jack.

t. Remove the audio patch cord between the VU METER jack and TK OUT jack.

u. Remove the tone keyer from the extension adapter.

v. Loosen the knurled thumbscrew on the bottom of the extension adapter and remove the adapter from the equipment shelf.

w. Reinstall the tone keyer in the equipment shelf and secure in place by tightening the knurled thumbscrew on the bottom of the unit.

5-39. CHANNEL LEVEL TONE KEYER ADJUSTMENTS. To adjust the composite audio output signal level of the 12 tone keyers in a given voice channel, proceed as follows:

a. Extend the lower equipment shelf of the channel being adjusted and rotate output attenuator R3 fully clockwise (fig. 3-2).

NOTE

An attenuator (resistor R3) is mounted on the rear of each equipment shelf. When two equipment shelves are connected together, to give twelve channels, only one attenuator is necessary. Therefore, the attenuator on the lower shelf is always set to the minimum attenuation position (fully clockwise). The top equipment shelves are 1A3, 1A5, 1A7, and 1A9; the lower equipment shelves are 1A4, 1A6, 1A8 and 1A10 (fig. 2-9).

b. Slide the lower equipment shelf back into the equipment rack and secure in position.

c. Extend the top equipment shelf of the channel being adjusted and rotate output attenuator R3 fully counterclockwise.

NOTE

Composite tone level requirements are different in each system. Consult the appropriate system manual, or system drawings, to determine the proper composite tone output level.

d. Set the attenuator control on the volume and current level indicator to the level stipulated in the system plans and the BRIDGING INPUT-TERMINATING INPUT switch to the TERMINATING INPUT position.

e. Connect an audio patch cord to the VU METER jack on the auxiliary portion of the patch panel.

f. Connect the other end of the audio patch cord to the TK MON OUT jack corresponding to the channel being adjusted.

g. Request that each subscriber, transmitting to the tone keyers in the channel being adjusted, send a steady mark signal.

h. Adjust output attenuator R3 on the top equipment shelf until the VU meter indicates 0 vu.

i. Remove the audio patch cord between the VT METER jack and TK MON OUT jack.

j. Slide the extended equipment shelf back into the equipment rack.

k. Inform each subscriber that normal traffic may be resumed.

5-40. TONE CONVERTER LEVEL ADJUSTMENTS.

5-41. The composite audio tone applied to the input of the tone converters and dc teleprinter keying signals generated by the output of the tone converters must be adjusted to a specific level to insure proper operation of the VFTG group. The adjustments must be performed by using the actual input and output lines in the system in which the VFTG group is installed. To adjust the input composite audio signal level, perform the procedures described in paragraph 5-42. To adjust the dc teleprinter keying current output of each tone converter, perform the procedures described in paragraph 5-43.

5-42. AUDIO LEVEL ADJUSTMENT. The composite audio signal input level is adjusted in accordance with the following procedures:

NOTE

Composite tone level requirements are different in each system. Consult the appropriate system manual, or system drawings, to determine the proper composite tone input level.

a. Set the attenuator control on the volume and current level indicator to the level stipulated in the system plans and the BRIDGING INPUT-TERMINATING INPUT switch to the TERMINATING INPUT position.

b. Connect an audio patch cord to the jack designated VU METER on the auxiliary portion of the patch panel.

c. Connect the other end of the audio patch cord to the jack designated TC MON IN corresponding to the channel being adjusted.

NOTE

An attenuator (resistor R2) is mounted on the rear of each equipment shelf. When two equipment shelves are connected together, to give twelve channels, only one attenuator is necessary. Therefore, the attenuator on the lower shelf is always set to the minimum attenuation position (fully clockwise). The top equipment shelves are 1A3, 1A5, 1A7 and 1A9; the lower equipment shelves are 1A4, 1A6, 1A8, and 1A10 (see fig. 2-9).

d. Extend the lower equipment shelf of the

channel being adjusted and rotate input attenuator R2 fully clockwise (fig. 3-2).

e. Slide the lower equipment shelf into the equipment rack and secure in position.

f. Extend the top equipment shelf of the channel to be adjusted.

g. Set the VTVM to the 3 volt ac scale.

h. Connect the VTVM test leads to jacks J2 and J3 on any one of the tone converters in the shelf being adjusted (fig. 3-1).

i. Request that each subscriber associated with the tone converters being adjusted transmit a steady mark signal; the volume and current level indicator should indicate the signal level stipulated in the system plans.

j. Adjust input attenuator R2 on the rear of the top equipment shelf for an indication of 0.775 vac on the VTVM.

k. Remove the VTVM test leads from the tone converter.

l. Slide the equipment shelf into the equipment rack and secure in position.

m. Remove the audio patch cord between the VU METER jack and the TC MON IN jack.

n. Inform each subscriber that normal traffic may be resumed.

5-43. **TELEPRINTER LOOP CURRENT ADJUSTMENT.** The dc current in each tone converter teleprinter loop is adjusted in accordance with the following procedure:

NOTE

The loop current control resistors are identified in table 3-4. Refer to this table to ascertain the control resistor to be adjusted.

a. Connect one end of a dc patch cord to the jack designated CURR IN on the auxiliary portion of the patch panel.

b. Connect the other end of the dc patch cord to the TC MON OUT jack associated with the tone converter teleprinter loop to be adjusted.

c. Request that the distant end subscriber,

assigned to the tone converter, transmit a steady mark signal.

d. Observe the current meter on the volume and current level indication panel, and rotate the current control resistor (table 3-4) corresponding to the teleprinter loop being adjusted, for a 60 ma current for neutral keying or a 20 ma current for polar keying.

e. Remove the dc patch cord from the TC MON OUT jack.

f. Inform the subscriber contacted that normal traffic may be resumed.

g. Repeat steps b through f for the remaining tone converter teleprinter loops to be adjusted.

h. Remove the dc patch cord from the CURR IN jack.

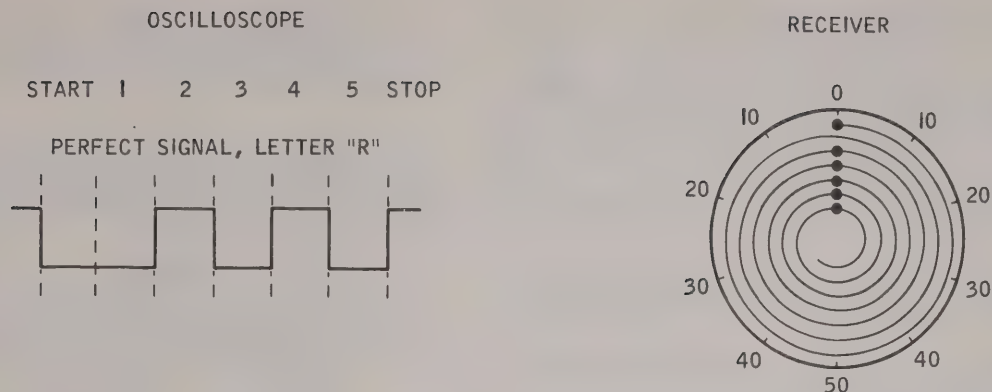
5-44. DISTORTION MEASUREMENT.

5-45. GENERAL.

5-46. The procedures contained herein enable you to evaluate the audio and dc teletype signals within the VFTG group so as to determine the percent of distortion introduced by the tone keys, tone converters, and transmission medium. System and equipment deterioration is detected by measurement of the following distortion percentages: Bias Distortion (uniform lengthening of mark and space elements); Speed Distortion (changes of modulation rate); Fortuitous Distortion (random displacement or breaking up of mark and space elements); Line Characteristic Distortion (received pulse length varies due to line reactance); Equipment Characteristic Distortion (dirty or bouncing relay contacts causing split characters); Cyclic Distortion (distortion resembling any of the above except that it is cyclic in nature); Total Distortion (the total of all forms of distortion). A typical nondistorted oscilloscope and TDMS receiver pattern are illustrated in figure 5-8.

NOTE

For a more comprehensive analysis of the teletype signals, an oscilloscope may be used in conjunction with the TDMS receiver. The vertical deflection is connected to the signal being measured; the beam intensity input (Z-axis) is connected to the Z-AXIS terminal on the receiver and the synchronizing input is connected to the SCOPE SYNCH terminal on the receiver.



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Figure 5-8. Display Pattern, TDMS Receiver and Oscilloscope (Zero Distortion)

5-47. The distortion measurements will be divided into three sections: paragraph 5-48 presents the procedures required to perform initial installation distortion measurements; paragraph 5-52 presents the procedures required to perform in-service measurements; paragraph 5-55 presents the procedures required to test the polar relay.

5-48. INITIAL INSTALLATION DISTORTION MEASUREMENTS.

5-49. Upon initial installation of the VFTG group the percentage of distortion introduced by the tone keyers and tone converters in each channel must be determined. To perform these measurements the audio tones generated by the tone keyers will be applied to the input of the tone converters; this arrangement is referred to as back-to-back operation. The VFTG group does not require external input or output circuits.

5-50. It is assumed that the equipments comprised in the VFTG group have been properly installed in accordance with the applicable installation instructions in Chapter 2, and applicable wiring diagrams in Chapter 6 of this manual. It is also assumed that the tone keyers and tone converters have been aligned in accordance with the procedures described in paragraphs 5-25 through 5-43 of this chapter.

5-51. To determine the percentage of distortion to audio and teletype signals within the VFTG group, proceed as follows:

a. Connect a dc patch cord to the jack designated TK EQUIP IN corresponding to the channel being adjusted.

b. Connect the other end of the dc patch cord to the jack designated TK LINE corresponding to a teletype subscriber in which the percentage of distortion is known.

c. Connect the other end of the dc patch cord to the jack designated TDMS RX on the auxiliary portion of the patch panel.

d. Connect a dc patch cord to the jack designated TC EQUIP OUT corresponding to the channel being adjusted.

e. Connect an audio patch cord to the jack designated TC EQUIP IN corresponding to the channel being adjusted.

f. Connect the other end of the audio patch cord to the jack designated TK EQUIP OUT corresponding to the channel being adjusted.

g. Connect an audio patch cord to the jack designated VU METER on the auxiliary portion of the patch panel.

h. Connect the other end of the audio patch cord to the jack designated TK MON OUT corresponding to the channel being adjusted.

i. Request that the teletype subscriber transmit a character.

NOTE

Maximum permissible distortion introduced by any element in a teletype system is dependent on the engineering criteria for the specific communications system. In the absence of other transmission standards, 5% should be considered the maximum tolerable distortion introduced by local teletype equipment.

j. Observe the signal level indicated on the VU meter. If the signal level is greater than 0 vu, patch one of the attenuators on the auxiliary portion of the patch panel between the tone keyer output and tone converter.

k. Adjust the TDMS receiver to measure the Bias Distortion.

l. Adjust the TDMS receiver to measure the Speed Distortion.

m. Adjust the TDMS receiver to measure the Fortuitous Distortion.

n. Adjust the TDMS receiver to measure the Line Characteristic Distortion.

o. Adjust the TDMS receiver to measure the Equipment Characteristic Distortion.

p. Adjust the TDMS receiver to measure the Cyclic Distortion.

q. Adjust the TDMS receiver to measure the Total Distortion.

r. Remove the audio and dc patch cords from the patch panel and repeat steps a through g for the remaining channels.

s. Remove the audio and dc patch cords from the patch panel.

5-52. IN-SERVICE DISTORTION MEASUREMENTS.

5-53. Upon completion of initial installation, after repair or maintenance procedures, or as directed by the station supervisor, the VFTG group must be tested for distortion of signals transmitted or received from the various subscribers. These measurements may be made using either the teletype equipment or distortion measuring test equipment at the distant transmitting end.

5-54. The distortion introduced into the VFTG group through the transmission medium and equipments within the system itself, may be determined in accordance with the following procedure:

a. Request the distant end teletype terminal to measure the distortion on the teletype signal being transmitted to the VFTG group; the distortion at the distant end must be within tolerances before proceeding.

b. Adjust the TDMS receiver to receive the proper keying input, modulation rate, and code elements being transmitted from the distant end.

c. Connect a dc patch cord to the jack designated TDMS RS on the auxiliary portion of the patch panel.

d. Connect the other end of the dc patch cord to the jack designated TC MON OUT corresponding to the tone converter to which the distant end is transmitting.

NOTE

The maximum permissible distortion introduced by a teletype system including the transmission medium is dependent on engineering criteria for the specific communications system. In the absence of other transmission standards 10% should be considered the maximum tolerable distortion introduced by the system.

e. Adjust the TDMS receiver to measure the Bias Distortion; record this percentage.

g. Adjust the TDMS receiver to measure the Fortuitous Distortion; record this percentage.

h. Adjust the TDMS receiver to measure the Line Characteristic Distortion; record this percentage.

i. Adjust the TDMS receiver to measure the Equipment Characteristic Distortion; record this percentage.

j. Adjust the TDMS receiver to measure the Cyclic Distortion; record this percentage.

k. Adjust the TDMS receiver to measure the Total Distortion; record this percentage.

l. Remove the dc patch cord from the jack designated TC MON OUT corresponding to the tone converter being tested.

m. Repeat steps a through l for the remaining tone converters to be tested.

n. Remove the other end of the patch cord from the jack designated TDMS RX on the auxiliary portion of the patch panel.

o. Compare the results obtained by the distortion measurements with those relayed by the transmitting end; total distortion must not exceed 10%.

p. Request the local teletype subscriber associated with the channel being tested to transmit a signal.

q. Adjust the TDMS receiver to receive the proper keying input, modulation rate, and code elements being transmitted by the local subscriber.

r. Connect a dc patch cord to the jack designated TDMS RX on the auxiliary portion of the patch panel.

s. Connect the other end of the dc patch cord to the TK MON IN jack corresponding to the tone keyer being tested.

t. Measure the distortion on the teletype signal being transmitted and relay this information to the distant teletype terminal to which the signal is being transmitted.

u. Request the distant receiving terminal to connect a distortion measuring set (TDMS receiver or equivalent) to the teleprinter output and measure the signals for the following distortions:

- (1) Bias Distortion
- (2) Speed Distortion
- (3) Fortuitous Distortion
- (4) Line Characteristic Distortion
- (5) Equipment Characteristic Distortion
- (6) Cyclic Distortion
- (7) Total Distortion

v. Compare the results obtained by the distortion measurements with those relayed from the distant end receiver; total distortion must not exceed 10%.

w. Remove the dc patch cord from the jack designated TK MON IN corresponding to the one keyer being tested.

x. Repeat steps p through w for the remaining tone keyers to be tested.

y. Remove the other end of the dc patch cord from the jack designated TDMS RX on the auxiliary portion of the patch panel.

5-55. POLAR RELAY TEST PROCEDURE.

5-56. The mechanical relays in the tone converters are subject to wear which may introduce distortion to the teleprinter keying signal. These relays are tested in accordance with the following procedures:

a. Adjust the TDMS transmitter to test the polar relay.

b. Insert the connector of the TDMS relay test adapter in the front panel receptacle of the test transmitter and engage the two retaining clips that secure the adapter in place.

c. Set RANGE and VERNIER controls to the baud rate of the system in which the relay is used.

d. Set the DISPLAY switch to BIAS and the SIGNAL SELECTOR to 1:1 reversals.

e. Plug the relay into the octal socket on the relay adapter.

f. Observe the test transmitter oscilloscope screen for a pattern of one of two dots positioned on the circular trace.

NOTE

Zero distortion is indicated when the two bright dots are superimposed. Relay bias is indicated by an angular separation of the two dots with each scale division equal to 1% bias. Bias should not exceed 5%.

g. Set the DISPLAY switch to TRANSIT TIME; an arc on the circular trace should be intensified showing relay contact transit time.

h. Relay contact bounce is indicated by bright dots near the ends of the arc; if contact bounce is observed, the relay should be replaced.

SECTION II SPECIAL MAINTENANCE

NOT APPLICABLE

CHAPTER 6

CIRCUIT DIAGRAMS

6-1. PURPOSE.

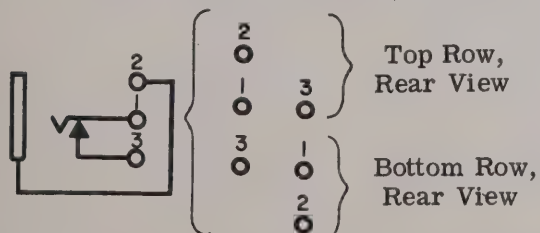
6-2. The purpose of this chapter is to identify the various circuits and components of the VFTG group which are not covered in the individual equipment manuals. Each circuit diagram is designed to give you a better understanding of the equipment and to help in installing and maintaining the equipment.

6-3. SCOPE.

6-4. This chapter provides the schematic diagrams of equipments which are not covered by individual technical manuals, and cabling diagrams illustrating the connection of the system interconnecting cable. Also included are parts location illustrations (fig. 6-7 through 6-13), keyed to appendixes B and D.

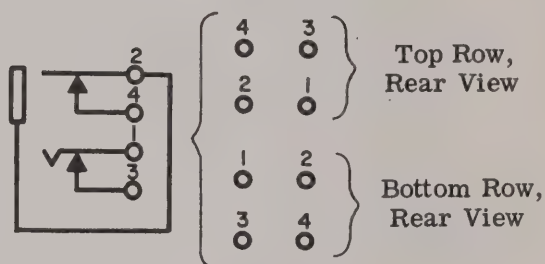
6-5. CIRCUIT DIAGRAM REFERENCE DATA.

6-6. All graphic electrical and electronic symbols conform to MIL-STD-15-1A except for the following associated with the Patch Panel:



⊙ Patch Panel Jack Input

* Normal-Through Switching Jack



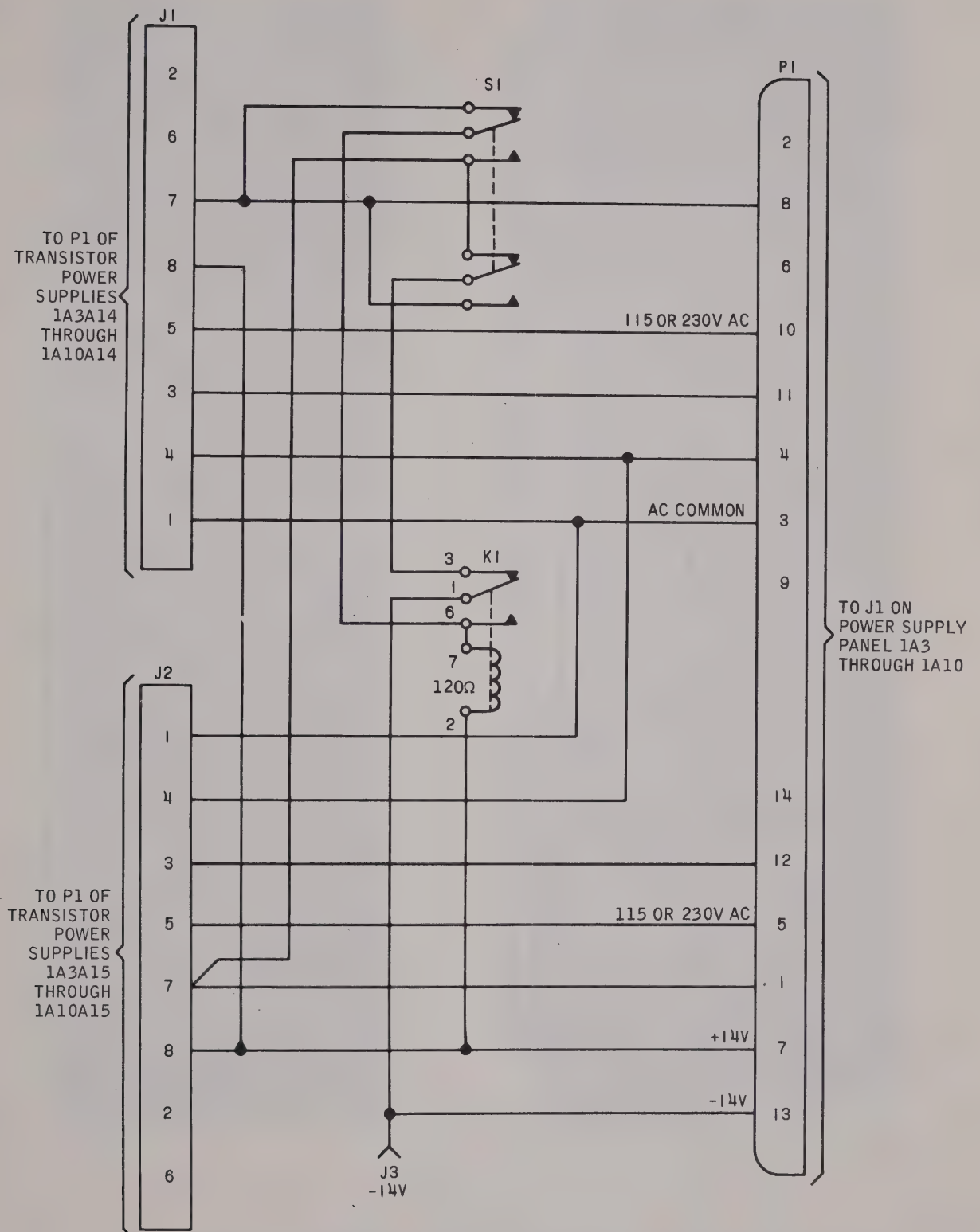
6-7. All abbreviations used in this manual conform to MIL-STD-12 with the following exceptions:

NRC	Northern Radio Corporation
PS	power supply
E	terminal strip
FS	frequency shift
SP	strapping panel (line battery voltage)

6-8. The following statements are applicable to the circuit diagrams contained in this chapter.

a. Component values are indicated in ohms and microfarads unless otherwise specified.

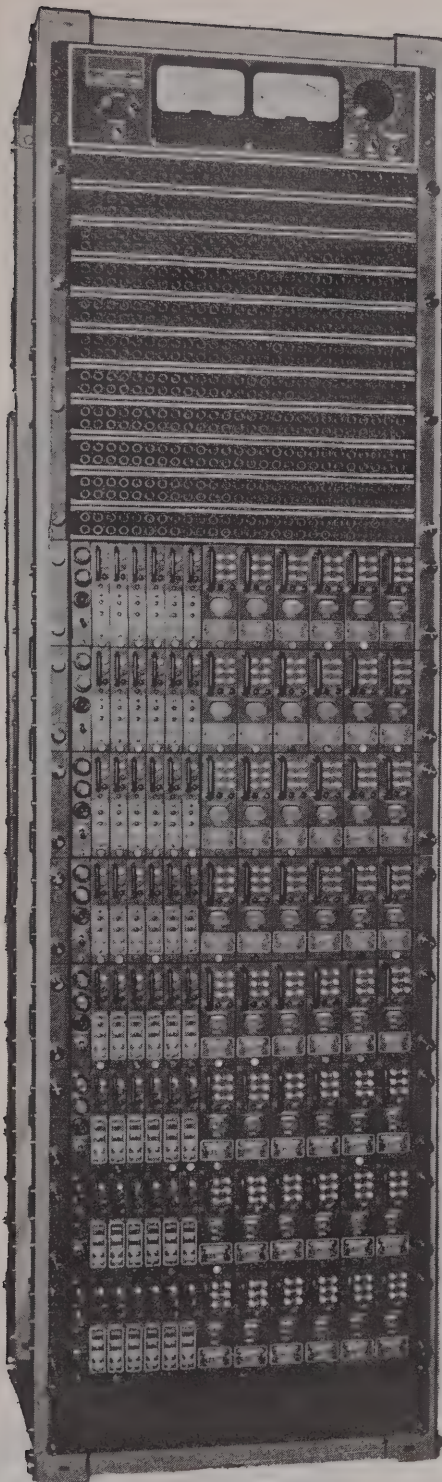
b. All diagrams containing wires, shown directly terminated inside assembly or subassembly blocks, without connectors, are solder connected wires.



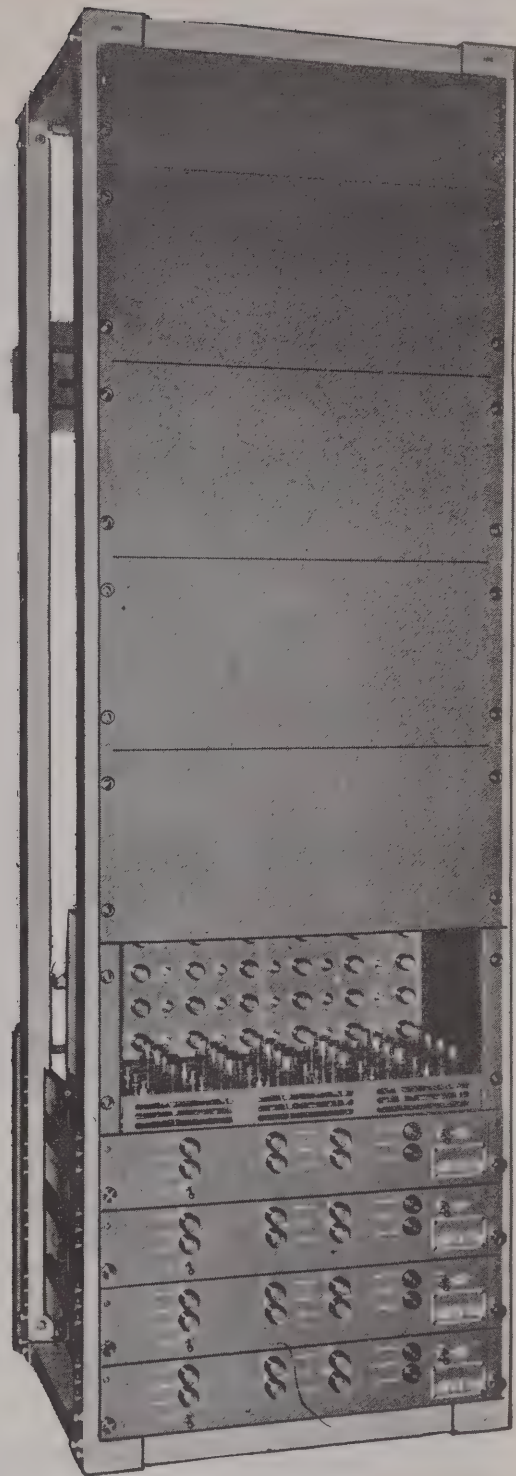
NOTE:
REFERENCE DESIGNATIONS ARE ABBREVIATED.
PREFIX DESIGNATIONS WITH 1A3 THROUGH 1A10

9421/8612-042

Figure 6-4. Power Supply Transfer Control, Schematic Diagram



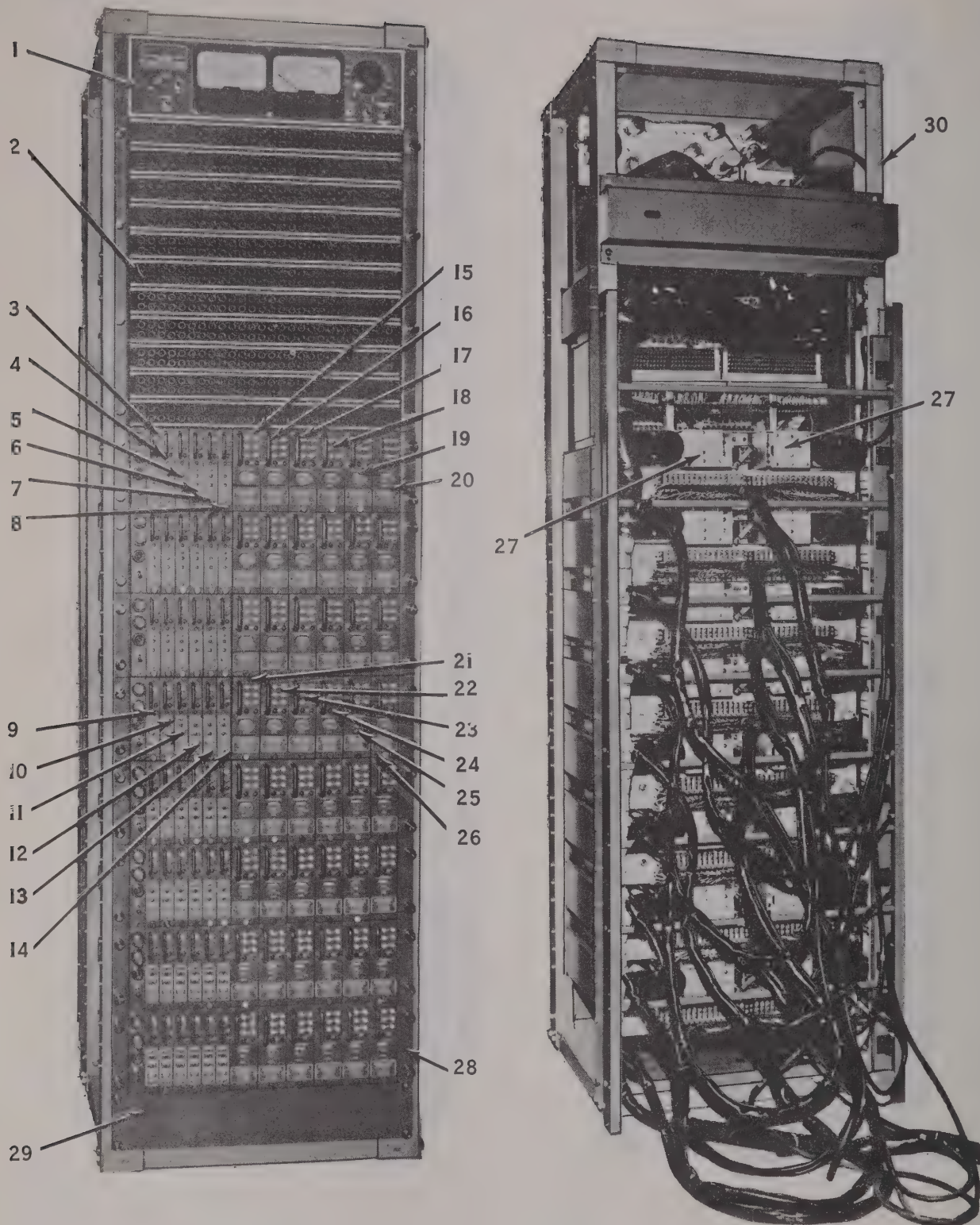
1



2

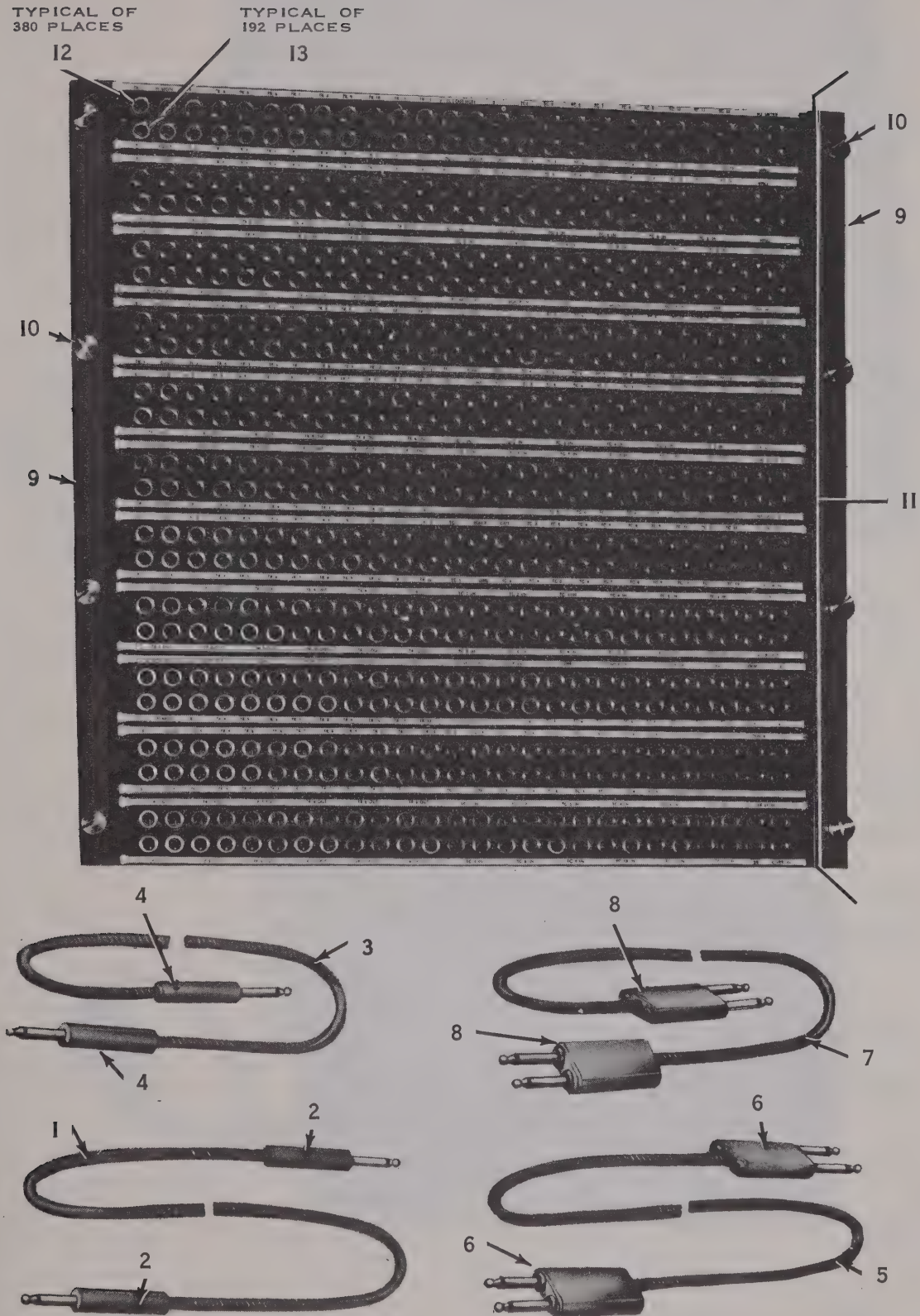
B421/6612 - 101

FIGURE 6-7. MULTIPLEXER GROUP OA-7008/MRC-85(V)2.



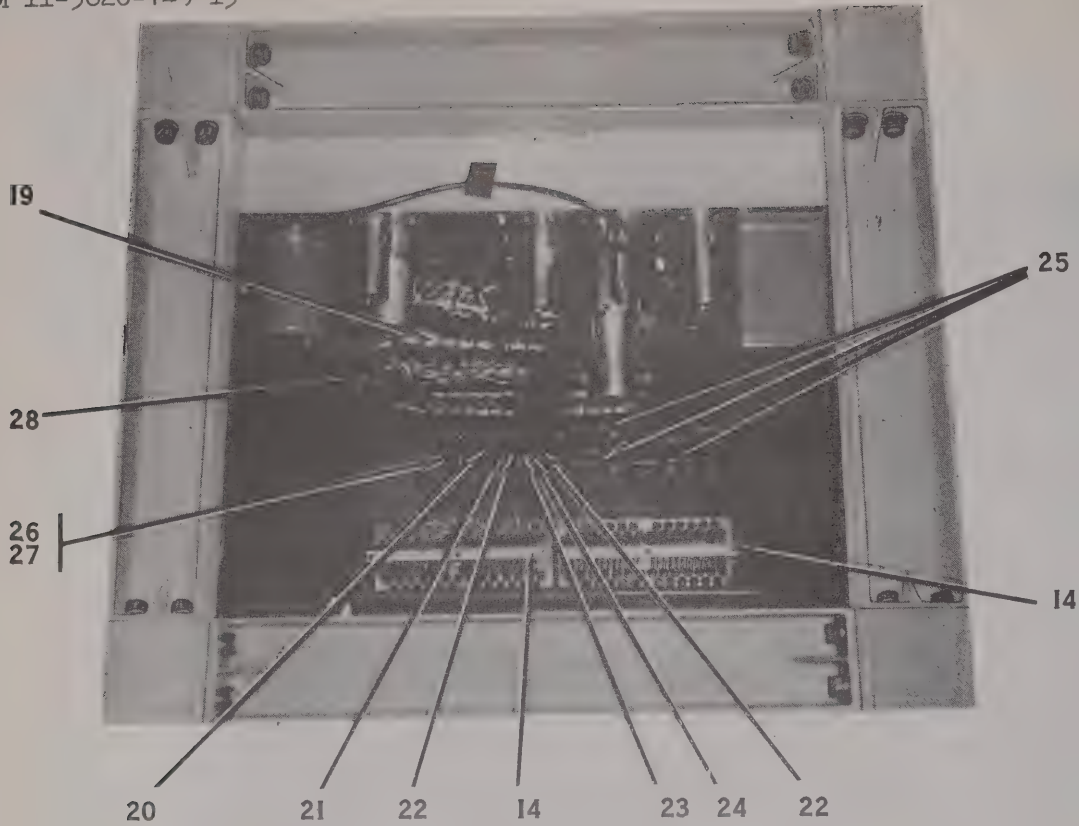
B421/6612 - 102

FIGURE 6-8. MULTIPLEXER GROUP SUBASSEMBLY.

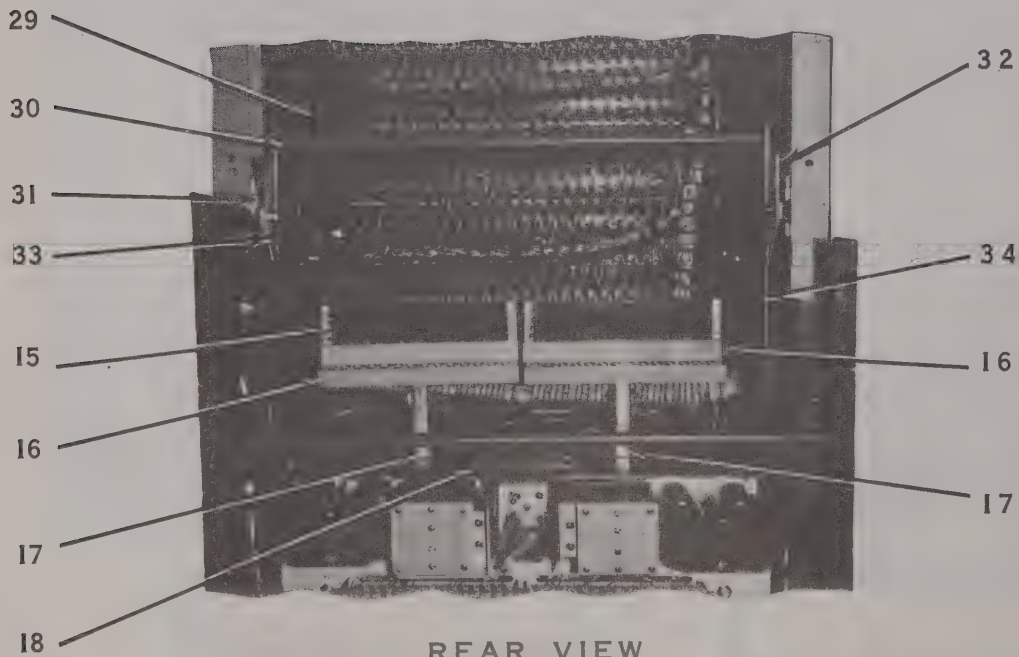


B421/8612 - 103 (1)

Figure 6-9(1). Communications Patching Panel SB-2322/MRC-85(V)2 (Sheet 1 of 2)



TOP VIEW

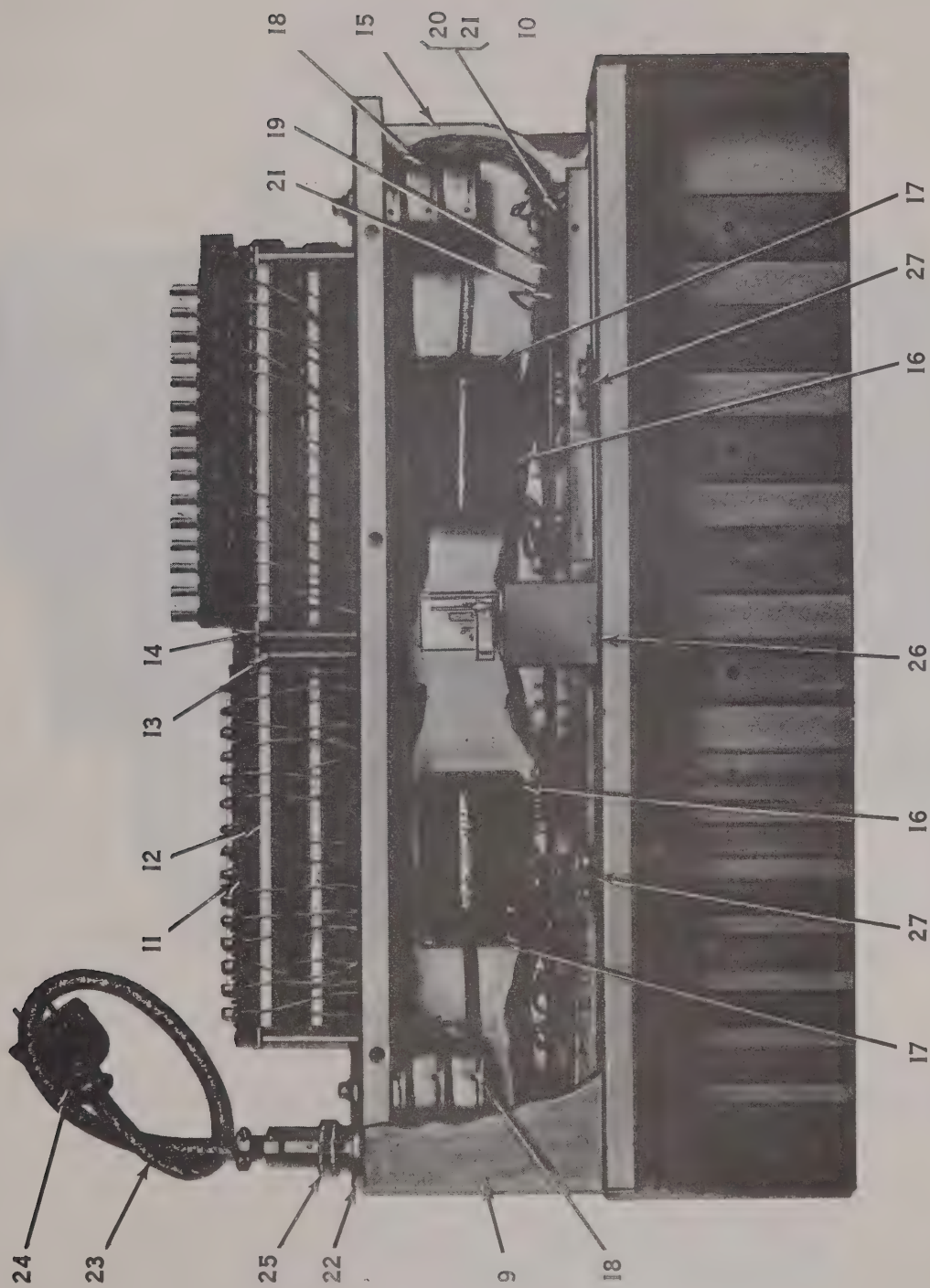


REAR VIEW

B 421/8612-104

Figure 6-9 (2).

COMMUNICATIONS PATCHING PANEL
SB-2322/MRC-85(V)2 (SHEET 2 OF 2)



B421/3612-108

Figure 6-10(1). Multiplexer Subassembly MX-3651/GGA-10 (Sheet 1 of 2)

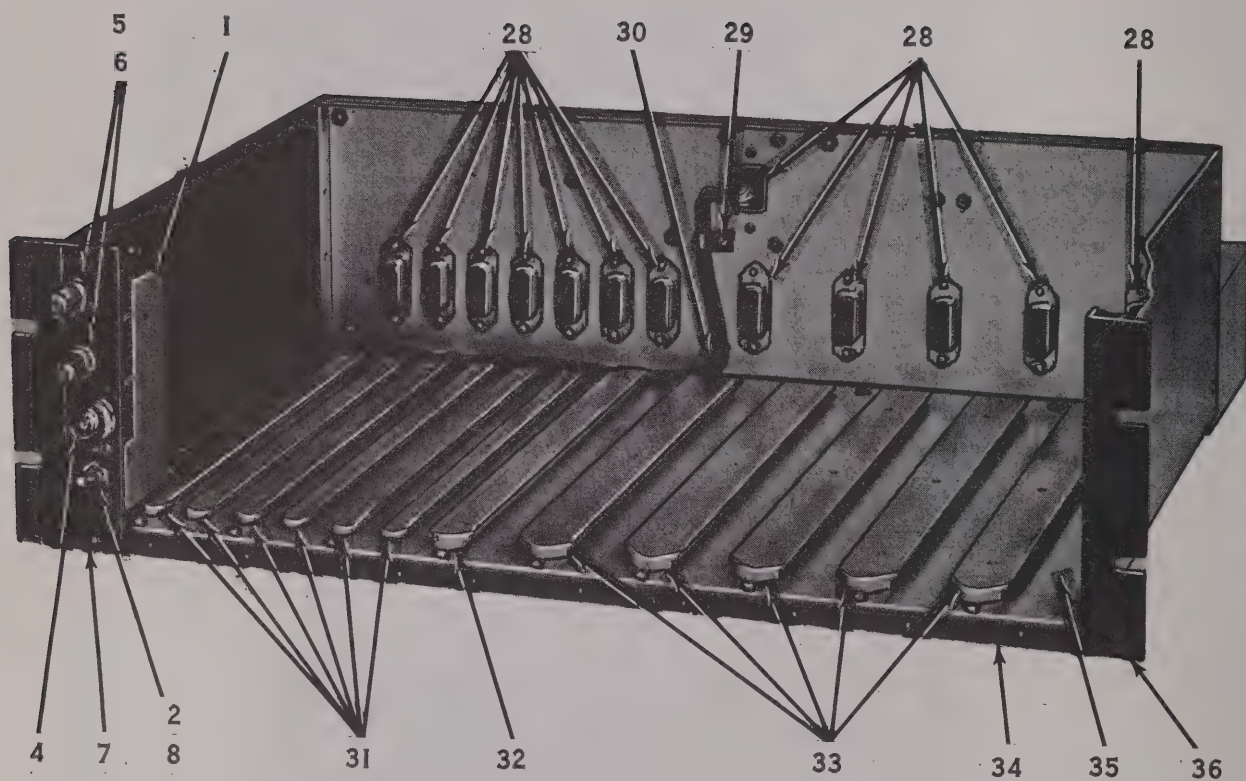
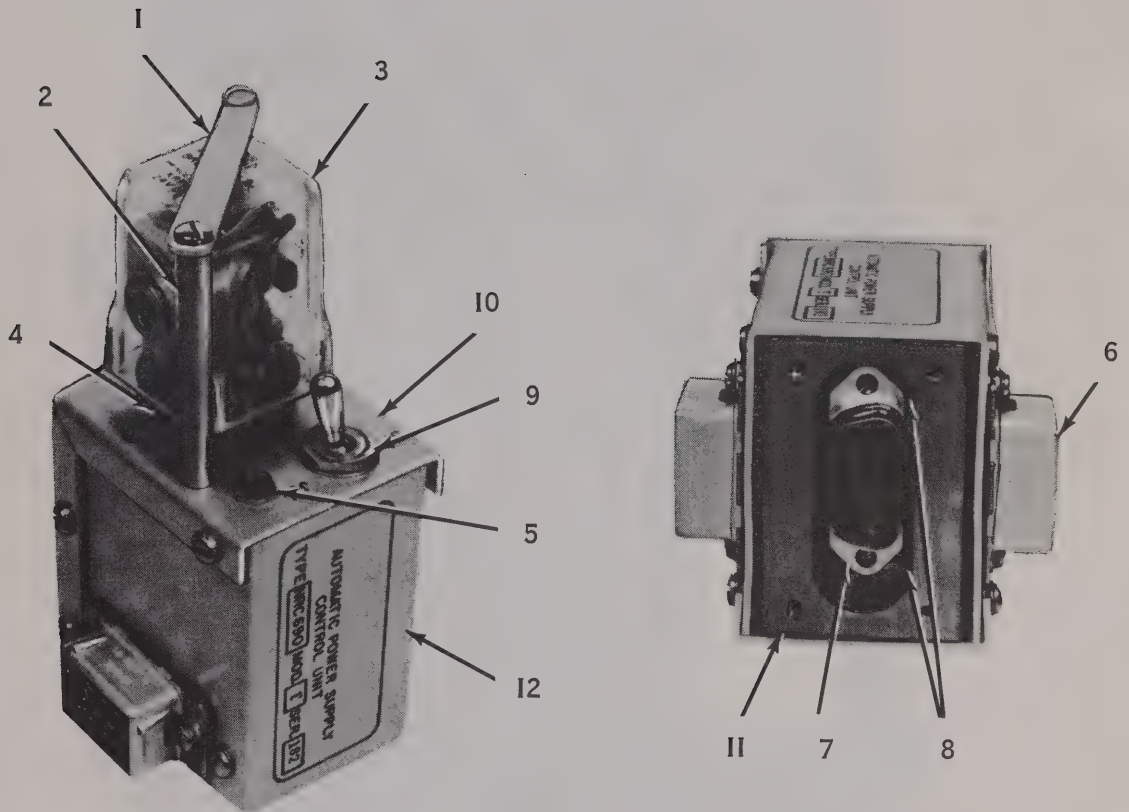
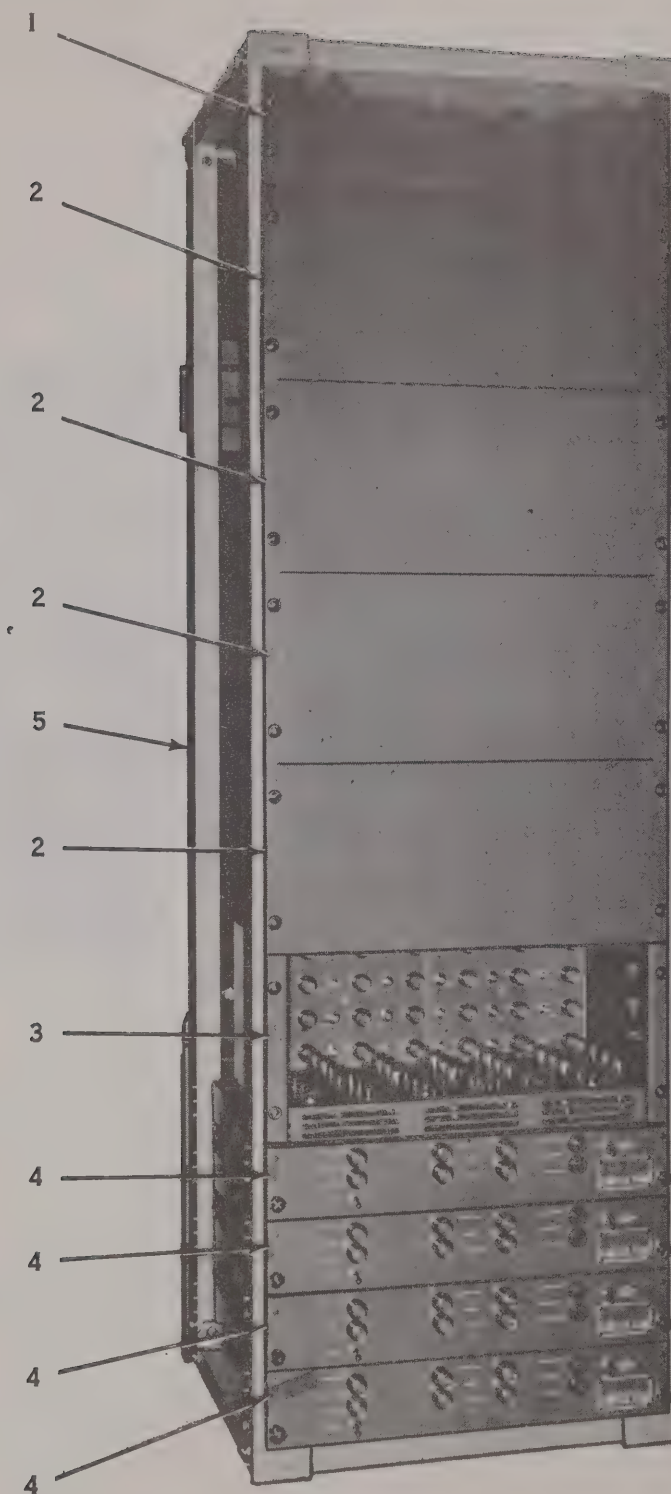


Figure 6-10(2). Multiplexer Subassembly MX-3651/GGA-10 (Sheet 2 of 2)



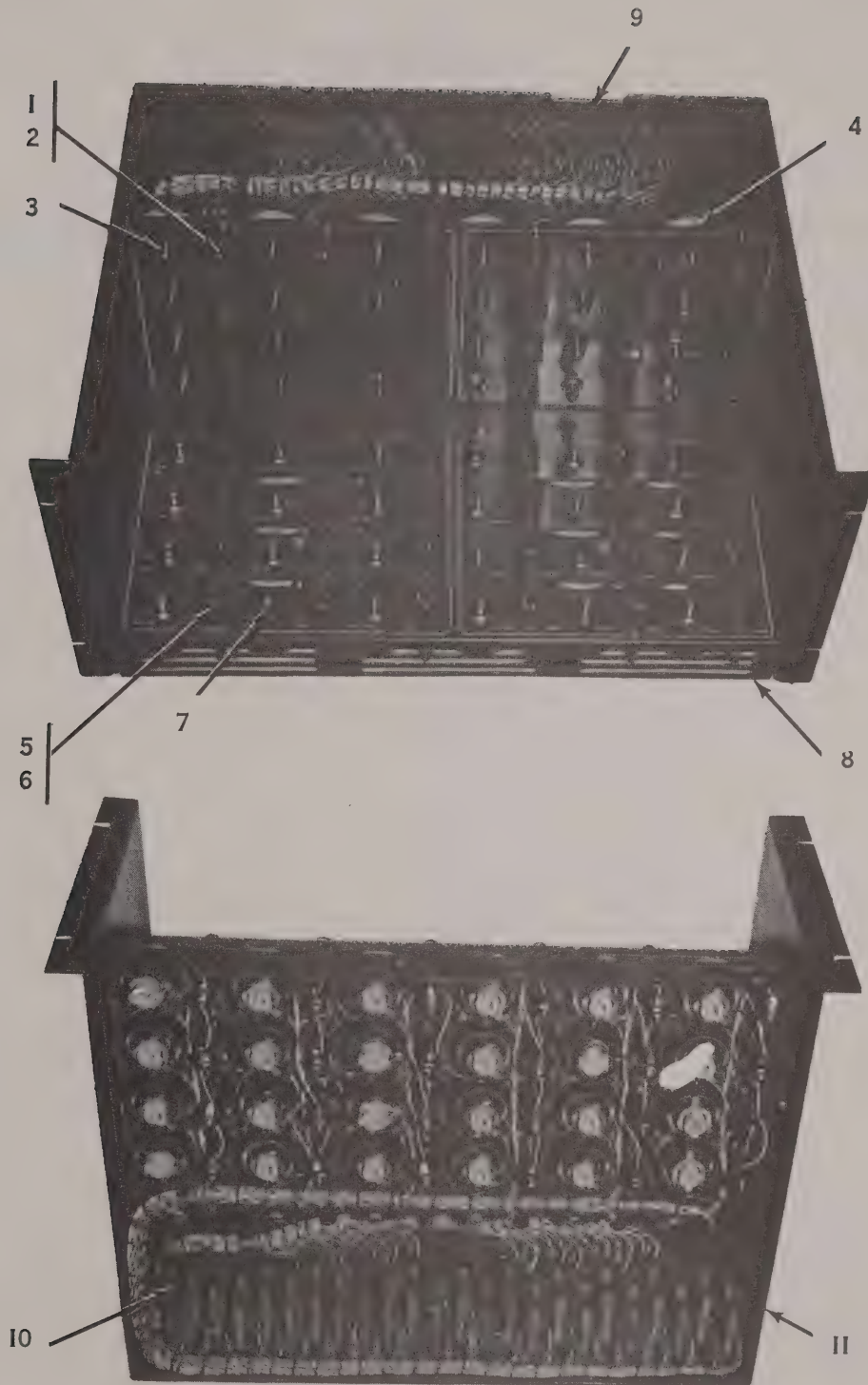
B421/8612-107

FIGURE 6-II. POWER SUPPLY TRANSFER CONTROL G-3877/GGA-10



B421/8612-108

Figure 6-12. Multiplexer Group Subassembly



B421/8612-109

FIGURE 6-13. ELECTRICAL SYSTEM PROTECTION PANEL SB-2328/MRC-85(V)2

APPENDIX A

REFERENCES

The following publications contain information applicable to the operation and maintenance of Multiplexer Group OA-7008/MRC-75(V)2

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders
TM 11-5805-325-12	Operator and Organizational Maintenance Manual: Terminal, Telegraph AN/FGC-61A
TM 11-5805-325-35	Field and Depot Maintenance Manual: Terminal, Telegraph AN/FGC-61A
TM 11-5820-749-15	Organizational, DS, GS, and Depot Maintenance Manual: Panel, Indicator SB-2323/MRC-85(V)2 (Northern Radio Type 254, Model 1). (Including Repair Parts and Special Tool Lists.

APPENDIX B

BASIC ISSUE ITEMS

Section I. INTRODUCTION

B-1. Scope

This appendix lists items comprising an operable equipment and those required for installation, operation, or operator's maintenance for Multi-plexer Group OA-7008/MRC-85(V)2.

B-2. Explanation of Columns

The following is an explanation of columns in section II.

a. Source, Maintenance, and Recoverability Codes (SMR) Column. The SMR codes used in this list are:

(1) *Source code (A).* The selection status and sources for the listed item is indicated in this column. The source codes used and their explanations are:

Code	Explanation
P	Applies to repair parts that are stocked in or supplied from GSA/DSA, or Army supply system, and authorized for use at indicated maintenance categories.
A	Applies to assemblies that are not procured or stocked as such but are made up of two or more units, each of which carries an individual stock number and description and is procured and stocked and can be assembled by units at indicated maintenance categories.
X2	Applies to repair parts that are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels.

(2) *Maintenance code (B).* The lowest category of maintenance authorized to install the item is indicated in this column. The maintenance categories and their explanations are:

Code	Explanation
O	Organizational maintenance
F	Direct support maintenance

(3) *Recoverability code (C).* This column lists the recoverability code. It indicates whether unserviceable items should be returned for recovery or salvage. Recoverability code and its explanation is as follows:

Note. When no code is indicated in the recoverability column, the part will be considered expendable.

Code	Explanation
R	Applies to repair parts and assemblies that are economically repairable at DSU and GSU activities and are normally furnished by supply on an exchange basis.

b. Federal Stock Number Column. This column indicates the Federal stock number for the item.

c. Description Column. This column includes the Federal item name and any additional description of the item which may be required. Where applicable the five-digit Federal supply code for the manufacturers is followed by a part number or other reference number. Model column is not used.

d. Unit of Issue Column. The unit used as a basis of issue (e.g., ea, pr, ft, yd, etc.) is given in this column.

e. Quantity Incorporated in Unit Pack Column. Not used.

f. Quantity Incorporated in Unit Column. The total quantity of the item used in the equipment is given in this column.

g. Quantity Authorized Column. This column lists the quantity of the item supplied for initial operation of the equipment and/or quantities authorized to be kept on hand by the operator for maintenance of the equipment.

h. Illustrations Column.

(1) *Figure number A.* The number of the illustration on which the item is shown is indicated in this column.

(2) *Item or symbol number (B).* The item number callout used to reference the item on the illustration appears in this column.

SECTION II. BASIC ISSUE ITEMS LIST

(1) SOURCE CD	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS	
												(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER
			1	2	3	4	5	6					
A	O R								ea	1	1	6-7	
		MULTIPLEXER GROUP OA-7008/MRC-85(V)2: 88183; TYPE 283 MODEL 1 (This item is nonexpendable)											
		TECHNICAL MANUAL 5820-715-15 Requisition through pinpoint account number if assigned; otherwise through nearest Adjutant General facility.							ea	1	1		
		NOTE: For technical manuals the quantity indicates the maximum number of copies authorized for packing (or issue) with the equipment. Where a number of these equipment are concentrated in a small area, the quantity on hand may be reduced to practical levels. Excess publications must be returned to publication supply centers through AG channels.											
A	O R	CONTROL, POWER SUPPLY C-6369/MRC-85(V)2: 88183; TYPE 227 MODEL 1							ea	4	4	6-12	4
A	O R	CONTROL, POWER SUPPLY TRANSFER FERC-3877/GGA-10: 88183; 6-1030-1							ea	8	8	6-10	26
A	O R	CONVERTER, FREQUENCY SHIFT CV-1201/GGA-10: 88183; 6-1053-1							ea	4	4	6-8	15
A	O R	CONVERTER, FREQUENCY SHIFT CV-1206/GGA-10: 88183; 6-1053-6							ea	4	4	6-8	20
A	O R	CONVERTER, FREQUENCY SHIFT CV-1207/GGA-10: 88183; 6-1053-7							ea	4	4	6-8	21

BASIC ISSUE ITEMS LIST													
(1)	(2)	(3)						(4)	(5)	(6)	(7)	(8)	
		FEDERAL STOCK NUMBER	DESCRIPTION									UNIT OF ISSUE	QTY INC IN UNIT PACK
1	2		3	4	5	6	(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER					
A O R							CONVERTER, FREQUENCY SHIFT CV-1208/GGA-10: 88183; 6-1053-8	ea		4	4	6-8	22
A O R							CONVERTER, FREQUENCY SHIFT CV-1209/GGA-10: 88183; 6-1053-9	ea		4	4	6-8	23
A O R							CONVERTER, FREQUENCY SHIFT CV-1210/GGA-10: 88183; 6-1053-10	ea		4	4	6-8	24
A O R							CONVERTER, FREQUENCY SHIFT CV-1211/GGA-10: 88183; 6-1053-11	ea		4	4	6-8	25
A O R							CONVERTER, FREQUENCY SHIFT CV-1212/GGA-10: 88183; 6-1053-12	ea		4	4	6-8	26
A O R							CONVERTER, FREQUENCY SHIFT CV-1461/GGA-10: 88183; 6-1053-2	ea		4	4	6-8	16
A O R							CONVERTER, FREQUENCY SHIFT CV-1462/GGA-10: 88183; 6-1053-3	ea		4	4	6-8	17
A O R							CONVERTER, FREQUENCY SHIFT CV-1463/GGA-10: 88183; 6-1053-4	ea		4	4	6-8	18
A O R							CONVERTER, FREQUENCY SHIFT CV-1464/GGA-10: 88183; 6-1053-5	ea		4	4	6-8	19
A O R							KEYER, FREQUENCY SHIFT KY-390/GGA-10: 88183; 6-1041-11	ea		4	4	6-8	13
A O R							KEYER, FREQUENCY SHIFT KY-391/GGA-10: 88183; 6-1041-3	ea		4	4	6-8	5
A O R							KEYER, FREQUENCY SHIFT KY-392/GGA-10: 88183; 6-1041-10	ea		4	4	6-8	12
A O R							KEYER, FREQUENCY SHIFT KY-393/GGA-10: 88183; 6-1041-4	ea		4	4	6-8	6

BASIC ISSUE ITEMS LIST														
(1) SOURCE CD	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UNIT PACK	(6) QTY INC IN UNIT	(7) QTY AUTH	(8) ILLUSTRATIONS		
												(a) FIGURE NUMBER	(b) ITEM OR SYMBOL NUMBER	
(a)	(b)	(c)												
			MODEL											
1	2	3	4	5	6									
A	O	R	KEYER, FREQUENCY SHIFT KY-394/GGA-10: 88183; 6-1041-12						ea		4	4	6-8	14
A	O	R	KEYER, FREQUENCY SHIFT KY-395/GGA-10: 88183; 6-1041-2						ea		4	4	6-8	4
A	O	R	KEYER, FREQUENCY SHIFT KY-396/GGA-10: 88183; 6-1041-5						ea		4	4	6-8	7
A	O	R	KEYER, FREQUENCY SHIFT KY-397/GGA-10: 88183; 6-1041-9						ea		4	4	6-8	11
A	O	R	KEYER, FREQUENCY SHIFT KY-398/GGA-10: 88183; 6-1041-8						ea		4	4	6-8	10
A	O	R	KEYER, FREQUENCY SHIFT KY-399/GGA-10: 88183; 6-1041-7						ea		4	4	6-8	9
A	O	R	KEYER, FREQUENCY SHIFT KY-400/GGA-10: 88183; 6-1041-6						ea		4	4	6-8	8
A	O	R	KEYER, FREQUENCY SHIFT KY-401/GGA-10: 88183; 6-1041-1						ea		4	4	6-8	3
A	O	R	MULTIPLEXER SUBASSEMBLY MX-3651/GGA-10: 88183; TYPE 239 MODEL 1						ea		8	8	6-8	28
A	O	R	PANEL, INDICATOR SB-2323/MRC-85(V)2: 88183; TYPE 254 MODEL 1						ea		1	1	6-8	1
A	O	R	PANEL, PATCHING, COMMUNICATION SB-2322/MRC-85(V)2: 88183; TYPE 24 MODEL 8						ea		1	1	6-8	2
A	O	R	PANEL, PROTECTION, ELECTRICAL SYSTEM SB-2328/MRC-85(V)2: 88183; TYPE 252 MODEL 2						ea		1	1	6-12	2
A	O	R	POWER SUPPLY PP-2807/GGA-10: 88183; TYPE 223 MODEL 1						ea		16	16	6-8	27

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APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Multiplexer Group OA-7008/MRC-85(V)2. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Explanation of Format for Maintenance Allocation Chart

a. Group Number. Group numbers correspond to the reference designation prefix assigned in accordance with ASA Y32.16, *Electrical and Electronics Reference Designation*. They indicate the relation of listed items to the next higher assembly.

b. Component Assembly Nomenclature. This column lists the item names of component units, assemblies, subassemblies, and modules on which maintenance is authorized.

c. Maintenance Function. This column indicates the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform function at any category also includes authorization to perform that function at higher categories. The codes used to represent the various maintenance categories as follows:

Code	Maintenance category
C -----	Operator/crew
O -----	Organizational maintenance
F -----	Direct support maintenance
D -----	General support maintenance
H -----	Depot maintenance

d. Tools and Equipment. The numbers appearing in this column refer to specific tools and equipment which are identified by these numbers in section III.

e. Remarks. Self-explanatory.

C-3. Explanation of Format for Tool and Test Equipment Requirements

The columns in the tool and test equipment requirements chart are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tools for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. Not used.

e. Tool Number. Not used.

SECTION II MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
1	MULTIPLYER GROUP OA-7008/MRC-85(V)2 TYPE 238 MODEL 1	C O	O F				H						External Internal Voltage, Continuity & Resistance Voltage, Current, Distortion & Signal Level Refer to Procedures in T.O. 31M-2 MRC-85 -12 Fuses & Lamps Replace Modules, Defective Chassis Parts Repair PC Cards and Assemblies Returned from DSU Restore to Serviceable Condition
1A	PANEL, INDICATOR SE-2323 MRC-85(V)2 TYPE 254 MODEL 1	C O	O F		F								External Internal Voltage & Resistance Check Voltage, Continuity & Resistance Gain & Current Level Replace Knobs, Lamps & Fuses Replace Defective Parts

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MAINTENANCE ALLOCATION CHART														
GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS								TOOLS AND EQUIPMENT	REMARKS			
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE			REPAIR	OVERHAUL	REBUILD
1B	PANEL, PATCHING COMMUNICATIONS SB-2322/MEC-85(V)2 TYPE 240 MODEL VIII	C	O										9 8 8,9 8,9	External Internal Continuity Resistance Replace Defective Parts
1C	KEYER, FREQUENCY SHIFT KY-390/GGA-10 THRU KY-401/GGA-10	C	O										9 8 1,2,3,9,10,11 2,3,9,10,11	External Internal Voltage & Resistance Frequency, Signal Level, Audio Output Level Output Level
1D	CONVERTER, FREQUENCY SHIFT CV-1201/GGA-10, CV-1461/GGA-10 THRU CV-1464/GGA-10, CV-1206/GGA-10 THRU CV-1212/GGA-10	C	O										9 8 2,3,9,10,12 1 thru 6,9,10,12	Repair PC Cards Returned from DSU, Verify Repairs External Internal Voltage & Resistance Frequency Signal Level Audio Output Output & Current Level
													1 thru 10,12	Repair PC Cards Returned from DSU, Verify Repair

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
1	F,H,D	OA-7008/MRC-85(V)2 (Cont.)		
2	F,H,D	TEST OSCILLATOR HEWLETT-PACKARD 651B		
3	F,H,D	VTVM ME-26A/U		
4	F,H,D	OSCILLOSCOPE TEKTRONIX 503		
5	F,H,D	GENERATOR, SIGNAL SG-605A/MRM-9 TDMS TRANSMITTER		
6	F,H,D	FAULT LOCATOR TRANSMISSION LINE TS-2146A/MRM-9 TDMS RECEIVER		
7	F,H,D	RELAY TEST ADAPTER RADIATION 14-101		
8	F,H,D	POWER SUPPLY PP-4169A/MRM-9		
9	O,F,H,D	MULTIMETER AN/PSM-6		
10	F,H,D	TOOL KIT		
11	F,H,D	FREQUENCY COUNTER BERKELEY 7170 SUPPLIED W/AN/MRC-85		
12	F,H,D	TEST EXTENSION ADAPTER (KEYER) NRC-750 SUPPLIED		
		TEST EXTENSION ADAPTER (CONVERTER) NRC-751 SUPPLIED W/EQUIPMENT		

APPENDIX C

ORGANIZATIONAL, DS, GS, AND DEPOT REPAIR PARTS

Section I. INTRODUCTION

D-1. Scope

This appendix contains a list of repair parts required for the performance of organizational maintenance and a list covering the corresponding requirements for direct support, general support, and depot maintenance for Multiplexer Group OA-7008/MRC-85(V)2.

Note. No special tools, test and support equipment are required.

D-2. General

The repair parts list is divided into the following sections.

a. Prescribed Load Allowance (PLA), Section II. The PLA is a consolidated listing of repair parts allocated for initial stockage at organizational maintenance category. This is a mandatory minimum stockage allowance.

b. Repair Parts for Organizational Maintenance, Section III. Repair parts authorized for organizational maintenance are included in this section.

c. Repair Parts for Direct Support, General Support, and Depot Maintenance, Section IV. Repair parts authorized for direct support, general support, and depot maintenance are included in this section.

d. Federal Stock Number Cross-Reference Index, Section V. This is a cross-reference index of Federal stock numbers to figures and index numbers (item numbers).

D-3. Explanation of Columns

An explanation of the columns is given below.

a. Source, Maintenance, and Recoverability Codes (ABC) Column.

(1) *Source code (A).* The selection status and source for the listed item is noted here. Source codes and their explanations are as follows:

Code	Explanation
P	Applies to repair parts that are stocked in or supplied from GSA/DSA, or Army supply system, and authorized for use at indicated maintenance categories.
M	Applies to repair parts that are not procured or stocked but are to be manufactured at indicated maintenance categories.
A	Applies to assemblies that are not procured or stocked as such but are made up of two or more units, each of which carries an individual stock number and description and is procured and stocked and can be assembled by units at indicated maintenance categories.
X2	Applies to repair parts which are not procured. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels.
C	Applies to repair parts authorized for local procurement. If not obtainable from local procurement, such repair parts will be requisitioned through normal supply channels with a supporting statement of non-availability from local procurement.

(2) *Maintenance Code (B).* The lowest category of maintenance authorized to install the listed item is noted here.

Code	Explanation
O	Organizational maintenance
F	Direct support maintenance
H	General support maintenance

(3) *Recoverability code (C).* The information in this column indicates whether unserviceable items should be returned for recovery or salvage. Recoverability code and its explanation is as follows:

Note. When no code is indicated in the recoverability column, the part will be considered expendable.

Code	Explanation
R	Applies to repair parts and assemblies which are economically repairable at DSU and GSU activities and normally are furnished by supply on an exchange basis.

b. Federal Stock Number Column. The Federal stock number for the item is listed in this column.

c. Description Column. The sequence number, Federal item name, a five-digit manufacturer's code, an indenture code, and a part number are included in this column. For subsequent appearances of the same item, the manufacturer's code and part number is omitted. The words "same as" followed by the sequence number of the part when it first appeared in the list will follow the item name. The indenture codes indicate the end item, the assemblies, and the component parts. Identical codes are parts of the preceding higher code. An asterisk indicates attaching hardware. Model column is not used.

d. Unit of Issue Column. The unit used as a basis of issue (e.g., ea, pr, ft, yd, etc.) is indicated in this column.

e. Quantity Incorporated in Unit Pack Column. Not used.

f. Quantity Incorporated in Unit Column. The quantity of repair parts in an assembly is given in this column. Subsequent appearances of the same in the same assembly are indicated by the letters "REF."

g. Maintenance Allowance Column.

(1) The maintenance allowance columns are divided into subcolumns. The total quantity of items authorized for the number of equipments supported is indicated in each subcolumn opposite the first appearance of each item. Subsequent appearances of the same item will have no entry in the allowance columns, but will have a reference in the description column to the first appearance of the item. Items authorized for use as required, but not for initial stockage, are identified with an asterisk in the allowance column.

(2) The quantitative allowances for organizational category of maintenance represents one initial prescribed load for a 15-day period for the number of equipments supported. Units and organizations authorized additional prescribed loads will multiply the number of prescribed loads authorized by the quantity of repair parts reflected in the appropriate density column to obtain the total quantity of repair parts authorized.

(3) Subsequent changes to organizational allowances will be limited as follows: No change in the range of items is authorized. If additional items are considered necessary, recommendation should be forwarded to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-ME-NMP-P, Fort Monmouth, N.J. 07703, for exception or revision to the allowance

list. Revisions to the range of items authorized will be made based upon engineering experience, demand data, or TAERS information.

(4) The quantitative allowances for DS/GS categories of maintenance will represent initial stockage for a 30-day period for the number of equipments supported.

h. One-Year Allowances Per 100 Equipments, Contingency Planning Purposes Column. Opposite the first appearance of each item, the total quantity required for distribution and contingency planning purposes is indicated. The range of items indicates total quantities of all authorized items required to provide for adequate support of 100 equipments for 1 year.

i. Depot Maintenance Allowance Per 100 Equipments Column. This column indicates the total quantity of each item authorized depot maintenance for 100 equipments. Subsequent appearances of the same item will have no entry in this column, but will have a reference in the description column to the first appearance of the item.

j. Illustration Column.

(1) *Figure number (a).* The number of the illustration in which the item is shown is indicated in this column.

(2) *Item or symbol number (b).* The callout number used to reference the item in the illustration appears in this column.

D-4. Location of Repair Parts

a. When the Federal stock number is unknown follow the procedures given in (1) through (4) below.

(1) Use the table of contents to locate the appropriate appendix of the repair parts list.

(2) If the item number is available locate the item by scrutiny of columns 8b and/or 10b of the repair parts list.

(3) If the item or figure number is not known, check the description column (col. 3) in the repair parts list to locate the part.

(4) Locate the applicable illustration in this manual and note the figure number and item number. Use the repair parts listing and locate the figure number and item number as noted on the illustration.

b. When the Federal stock number is known, use the repair parts listing to find the repair part and the figure and item number as noted in the Federal stock number index.

D-5. Federal Supply Codes

This paragraph lists the Federal Supply code and the associated manufacturer's name.

Code	Manufacturer
01121 ----	Allen-Bradley Co.
02660 ----	Amphenol Corp.
06540 ----	Amatom Electronic Hardware Co., Inc.
15605 ----	Cutler Hammer, Inc.
24446 ----	General Electric Co.
24681 ----	Memcor Inc., Components Division
37942 ----	P. R. Mallory and Co., Inc.
44655 ----	Ohmite Mfg. Co.
68743 ----	Leonard Ward Electric Co.
70674 ----	ADC Products, Inc., Division of Magnetic Controls Co.

Code	Manufacturer
71400 ----	Bussman Mfg., Division of McGraw-Edison Co.
71688 ----	Cook Electric Co.
71785 ----	Cinch Mfg., Co. and Howard B. Jones Div.
72619 ----	Dialight Corp.
75382 ----	Kulka Electric Corp.
75915 ----	Littlefuse, Inc.
76385 ----	Minor Rubber Co., Inc.
77342 ----	American Machine and Foundry Co., Potter and Brumfield Division
77633 ----	Radio Engineering Laboratories
77881 ----	Rodale Mfg. Co., Inc.
79963 ----	Zierick Mfg. Corp.
81349 ----	Military Specifications
88183 ----	Northern Radio Co., Inc.
96906 ----	Military Standards
99141 ----	Lynch Communication Systems, Inc.

(1)	(2)	(3)				(4)
FEDERAL STOCK NUMBER	DESCRIPTION	15-DAY ORG. MAINT. ALLOWANCE				QTY INC IN UN PK
		(A)	(B)	(C)	(D)	
		1-5	6-20	21-50	51-100	
	MULTIPLEXER GROUP OA-7008/MRC-85(V)2: 88183; TYPE 283 MODEL 1					
5920-199-9498	F01180: FUSE, CARTRIDGE, 1/2 amp: 75915; 313-500	5	16	37	71	
5920-812-3654	F02070: FUSE, CARTRIDGE, 1/8 amp, 250V: 75915; 312-125	13	48	114	222	
6240-223-9100	F01160: LAMP, GLOW: 24446; NE51	2	2	4	8	

(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	
						15 DAY ORG. MAINT. ALW.				ILLUSTRATIONS	
						(a)	(b)	(c)	(d)	(A)	(B)
SOURCE CD	FEDERAL STOCK NUMBER	DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	(A)	(B)	(C)	(D)	FIGURE NUMBER	ITEM OR SYMBOL NUMBER	
P 0	6240-223-9100	MULTIPLEXER GROUP OA-7008/MRC-85(V)2: 88183 TYPE 283 MODEL 1	ea	8	2	2	4	8	6-10	4	
P 0	5920-199-9498	F01160: LAMP, GLOW; 24446; NE51 F01180: FUSE, CARTRIDGE, 1/2 amp; 75915; 313-500	ea	16	5	16	37	71	6-10	6	
P 0	5920-812-3654	F02070: FUSE, CARTRIDGE, 1/8 amp; 250V; 75915; 312-125	ea	48	13	48	114	222	6-13	1	

SECTION IV. REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE

SECTION IV. REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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SOURCE CD	(A) (B) (C)	MAINT. CD	REC. CODE	FEDERAL STOCK NUMBER		MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UNIT	30 DAY MAINT. ALW.						1 YR. ALW. PER 100 EQUIP.	CNTGTY PL. PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	ILLUSTRATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE										(10)							
(1)	(A)	(B)	(C)	(2)		(3)		(4)	(5)	(6)	(7)			(8)	(9)	(10)	
SOURCE CD		MAINT. CD		FEDERAL STOCK NUMBER		DESCRIPTION		UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UNIT	30 DAY MAINT. ALW.			PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	FIGURE NUMBER	ITEM OR SYMBOL NUMBER
																(A)	(B)

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																												
(1)		(2)				(3)										(4)	(5)	(6)	(7)						(8)	(9)	(10)	
(A) SOURCE CD	(B)(C) MAINT. CD	(C) REC. CODE	FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UNIT	30 DAY MAINT. ALW.						1 YR. ALW. PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER					
				1	2	3	4	5	6					DS (A)	DS (B)	DS (C)	GS (A)	GS (B)	GS (C)									
A	F	R							C	FO0150 KEYS, FREQUENCY SHIFT KY-399/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 6-1041-7			4												6-8		9	
A	F	R							C	FO0160 KEYS, FREQUENCY SHIFT KY-398/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 6-1041-8			4												6-8		10	
A	F	R							C	FO0170 KEYS, FREQUENCY SHIFT KY-397/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 6-1041-9			4												6-8		11	
A	F	R							C	FO0180 KEYS, FREQUENCY SHIFT KY-392/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 6-1041-10			4												6-8		12	
A	F	R							C	FO0190 KEYS, FREQUENCY SHIFT KY-390/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 6-1041-11			4												6-8		13	
A	F	R							C	FO0200 KEYS, FREQUENCY SHIFT KY-394/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 6-1041-12			4												6-8		14	

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE													(1)		(2)		(3)	(4)	(5)	(6)	(7)						(8)	(9)	(10)	
SOURCE CD	(A)	(B)	(C)	REC. CODE	FEDERAL STOCK NUMBER	MODEL						IND. CD			DESCRIPTION	UNIT OF ISSUE					QTY INC IN UN PK	QTY INC IN UN UNIT	30 DAY MAINT. ALW.						1 YR. ALW. PER 100 EQUIP.	CENTGCTY PL. PER 100 EQUIP.
						1	2	3	4	5	6		DS	GS			DS	GS	(A)	(B)			(C)	(A)	(B)	(C)	(A)	(B)		
A	F	R										C	F00210 CONVERTER, FREQUENCY SHIFT CV-1201/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-1			4										6-8	15			
A	F	R										C	F00220 CONVERTER, FREQUENCY SHIFT CV-1461/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-2			4										6-8	16			
A	F	R										C	F00230 CONVERTER, FREQUENCY SHIFT CV-1462/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-3			4										6-8	17			
A	F	R										C	F00240 CONVERTER, FREQUENCY SHIFT CV-1463/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-4			4										6-8	18			
A	F	R										C	F00250 CONVERTER, FREQUENCY SHIFT CV-1464/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-5			4										6-8	19			
A	F	R										C	F00260 CONVERTER, FREQUENCY SHIFT CV-1206/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-6			4										6-8	20			

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																									
(1)		(2)		(3)						(4)	(5)	(6)	(7)						(8)	(9)	(10)				
(A)	(B)	(C)	FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UN UNIT	30 DAY MAINT. ALW.						PER 100 EQUIP.	1 YR. ALW.	PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	ILLUSTRATION	
				1	2	3	4	5	6					IND. CD.	(A)	(B)	(C)	(A)	(B)					(C)	(A)
A	F	R								C F00270 CONVERTER, FREQUENCY SHIFT CV-1207/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-7						4								6-8	21
A	F	R								C F00280 CONVERTER, FREQUENCY SHIFT CV-1208/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-8						4								6-8	22
A	F	R								C F00290 CONVERTER, FREQUENCY SHIFT CV-1209/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-9						4								6-8	23
A	F	R								C F00300 CONVERTER, FREQUENCY SHIFT CV-1210/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-10						4								6-8	24
A	F	R								C F00310 CONVERTER, FREQUENCY SHIFT CV-1211/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-11						4								6-8	25
A	F	R								C F00320 CONVERTER, FREQUENCY SHIFT CV-1212/GGA-10 SEE INTRO FOR APPLICABLE TM 88183 6-1053-12						4								6-8	26

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE										(1)		(2)		(3)						(4)		(5)		(6)		(7)						(8)		(9)		(10)	
(A)	(B)	(C)	SOURCE CD	MAINT. CD	REC. CODE	FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UN UNIT	30 DAY MAINT. ALW.						PER 100 EQUIP	1 YR. ALW.	DEPOT MAINT. ALW. PER 100 EQUIP.	ILLUSTRATION		ITEM OR SYMBOL NUMBER									
							1	2	3	4	5	6					DS	(A)	(B)	(C)	GS	(A)				(B)	(C)		(A)	(B)							
A	F	R										C	F00330 POWER SUPPLY PP-2807/GGA-10 SEE INTRODUCTION FOR APPLICABLE TM 88183 TYPE223 MODEL1								16										6-8	27					
A	F	R										C	F00340 MULTIPLEXER SUBASSEMBLY MX-3651/GGA-10 SEE FIG. 4 88183 TYPE239 MODEL1								8										6-8	28					
C	F											C	F00350 PANEL,BLANK, 3-3/4 IN. W BY 19 IN. LG 88183 COML								1										6-8	29					
C	F											*	F00360 SCREW, MACHINE 88183 COML								8																
C	F											*	F00370 WASHER, FINISHING 88183 COML								8																
X2	F											C	F00380 RACK,ELECTRICAL EQUIPMENT MT-3325/MRC-85(V)2 7-0344								1										6-8	30					
A	F	R										C	F00390 PANEL,PATCHING, COMMUNICATION SB-2322/MRC-85(V)2 SEE FIG. 2 NHA SAME AS F00080							REF										6-9							
M	H											D	F00400 CORD ASSEMBLY, ELECTRICAL 70674 PJ12								7										6-9	1					

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																																							
(1)		(2)										(3)										(4)		(5)		(6)		(7)						(8)		(9)		(10)	
(A) SOURCE CD	(B) MAINT. CD	(C) REC. CODE	FEDERAL STOCK NUMBER						MODEL				DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UN	30 DAY MAINT. ALW.						(8) 1 YR. ALW. PER 100 EQUIP. CNTGCTY PL.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION									
			1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4				5	6	7	8	(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER												
P	F		59335-201-3181												E F00410 PLUG, TELEPHONE 70674 PJ1					4											4	6-9	2						
M	H														D F00420 CORD ASSEMBLY, ELECTRICAL 70674 PJ13					1											6-9	3							
P	F		59335-201-3181												E F00430 PLUG, TELEPHONE SAME AS F00410					REF											10	6-9	4						
M	H														D F00440 CORD ASSEMBLY, ELECTRICAL 70674 PJ52					7											6-9	5							
P	F		59335-848-6626												E F00450 PLUG, TELEPHONE 70674 PJ5					4											2	6-9	6						
M	H														D F00460 CORD ASSEMBLY, ELECTRICAL 70674 PJ53					1											6-9	7							
X2	F		59335-848-6626												E F00470 PLUG, TELEPHONE SAME AS F00450					REF												6-9	8						
X2	F														D F00480 STRIP, MOUNTING, FASTENER 88183 A240-8-18																6-9	9							
C	F														D F00490 THUMBSCREW 06540 6191-SS-1032					8											6-9	10							
X2	F														D F00500 INSERT, SCREW THREAD 06540 6322-8-1032					8											6-9	10							

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE										(1)		(10)																	
(A)	(B)	(C)	(2)		(3)						(4)	(5)	(6)	(7)						(8)	(9)	(10)							
SOURCE CD	MAINT. CD	REC. CODE	FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UN	30 DAY MAINT. ALW.						1 YR. ALW. PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	FIGURE NUMBER	ITEM OR SYMBOL NUMBER						
				1	2	3	4	5	6					DS	GS	(A)	(B)	(C)	(A)					(B)	(C)				
P	F		5935-835-4290							D F00510 JACK ASSEMBLY, TELEPHONE 70674 PJ340			11			1-20	21-50	51-100	1-20	21-50	51-100	2	2	2	19	11	6-9	11	
C	F									* F00520 SCREW, MACHINE 88183 COM1		44																	
C	F									* F00530 WASHER, FLAT 88183 COM1		44																	
C	F									* F00540 WASHER, LOCK 88183 COM1		44																	
C	F									* F00550 NUT, PLAIN, HEX. 88183 COM1		44																	
P	F		5935-192-4812							D F00560 JACK, TELEPHONE 70674 PJ318		380	8	20	38	11	10	10	10	433	380	6-9					12		
P	F		5935-947-1145							D F00570 JACK, TELEPHONE 70674 PJ117		192	4	11	20	6	6	5	231	192	6-9					13			
M	H									D F00580 PLATE, DESCRIPTION 88183 A9-0157		2															14		
C	F									* F00590 SCREW, MACHINE 88183 COM1		6															14		
M	H									D F00600 PLATE, DESCRIPTION 88183 A240-8-14		4															15		

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																									
(1) (A) SOURCE CD	(B) MAINT. CD	(C) REC. CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UN UNIT	(7) 30 DAY MAINT. ALW.									(8) 1 YR. ALW. PER 100 EQUIP.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION	
				MODEL									DS			GS									
1	2	3	4	5	6	CD	1	2	3	4	5	6	(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)	FIGURE NUMBER	ITEM OR SYMBOL NUMBER			
P	F						D	F00610 TERMINAL BOARD 71688 2-386						2	*	*	*	*	*	*	6-9	16			
C	F						*	F00620 SCREW, MACHINE 88183 COML					4												
C	F						*	F00630 WASHER, FLAT 88183 COML					4												
C	F						*	F00640 WASHER, LOCK 88183 COML					4												
C	F						*	F00650 NUT, PLAIN, HEX. 88183 COML					4												
X2	F						D	F00660 BAR, SUPPORT, TERMINAL BOARD 88183 A9-0154					2								6-9	17			
C	F						*	F00670 SCREW, MACHINE 88183 COML					2												
C	F						*	F00680 WASHER, FLAT 88183 COML					2												
C	F						*	F00690 WASHER, LOCK 88183 COML					2												
X2	F		5940-549-7530				D	F00700 TERMINAL BOARD 71785 8-140-3-4W					1								6-9	18			

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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SOURCE CD	(A)	(B)	(C)	FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UN	30 DAY MAINT. ALW.						PER 100 EQUIP. 1 YR. ALW. CNTGTY PL.	DEPOT MAINT. ALW. PER 100 EQUIP.	(A)	(B)	ITEM OR SYMBOL NUMBER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE													(10)																
(1)		(2)		(3)						(4)	(5)	(6)	(7)			(8)	(9)	(10)											
SOURCE CD	(A)	MAINT. CD	(B)	(C)	REC. CODE	FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UNIT	30 DAY MAINT. ALW.			1 YR. ALW. PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	FIGURE NUMBER	(A)	(B)	ITEM OR SYMBOL NUMBER				
							1	2	3	4	5	6					IND	CD	DS							GS	(C)		
C	F																										6-9	27	
C	F																										6-9	27	
X2	F																										6-9	28	
C	F																										6-9	29	
X2	F																												
C	F																												
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REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT,
AND DEPOT MAINTENANCE

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE										(7) 30 DAY MAINT. ALW.			(8) 1 YR. ALW. PER 100 EQUIP.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION	
(1) (A) SOURCE CD	(2) (B) FEDERAL STOCK NUMBER	(3) (C) DESCRIPTION	(4) MODEL						(5) QTY INC IN UNIT	(6) QTY INC IN UNIT	(7A) DS (A) 1-20 (B) 21-50 (C) 51-100	(7B) GS (A) 1-20 (B) 21-50 (C) 51-100	(8) PER 100 EQUIP.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10A) FIGURE NUMBER	(10B) ITEM OR SYMBOL NUMBER
			1	2	3	4	5	6								
C	F	* F01010 WASHER, FLAT 88183 COM1							2						6-9	31
C	F	* F01020 WASHER, LOCK 88183 COM1							2							
X2	F	D F01030 SLIDE ASSEMBLY, DRAWER 88183 NO NUMBER							2							
X2	F	D F01040 PANEL, LEFT SIDE 88183 C240-8-12							1						6-9	32
X2	F	D F01050 PANEL, RIGHT SIDE 88183 C240-8-11							1						6-9	33
C	F	* F01060 SCREW, MACHINE 88183 COM1							10							
C	F	* F01070 WASHER, FLAT 88183 COM1							10							
C	F	* F01080 WASHER, LOCK 88183 COM1							10							
C	F	* F01090 NUT, PLAIN, HEX. 88183 COM1							10							
X2	F	D F01100 CHASSIS, ELECTRICAL EQUIPMENT 88183 C240-8-10							1						6-9	34

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																							
(1) SOURCE CD	(A) MAINT. CD	(B)(C) REC. CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION							(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UNIT	(7) 30 DAY MAINT. ALW.						(8) 1 YR. ALW. PER 100 EQUIP. CNTG CY PL.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION	
				(3)										DS			GS					(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER
				1	2	3	4	5	6	7				(A)	(B)	(C)	(A)	(B)	(C)				
A	F	R							C	F01110 MULTIPLEXER SUBASSEMBLY MX-3651/GGA-10 SEE FIG. 2 NHA SAME AS F00340		REF							6-10				
X2	F								D	F01120 PANEL, POWER CONTROL 88183 6-1033	8								6-10				
X2	F								E	F01130 SHIELD 88183 C5-0665	8								6-10	1			
P	F		5930-286-2598						E	F01140 SWITCH, TOGGLE 15605 8360K7	8	2	2	3	2	2	2	40	24	6-10	2		
P	F		6250-683-0320						E	F01150 LIGHT, INDICATOR 72619 26408-1137	8	3	9	16	5	3	4	198	160	6-10	3		
P	D		6240-223-9100						E	F01160 LAMP, GLOW 24446 NE51	8	3	9	16	5	3	4	198	160	6-10	4		
P	F		5920-577-2264						E	F01170 FUSEHOLDER 71400 HKLX	64	2	4	7	3	2	2	89	64	6-10	5		
P	D		5920-199-9498						E	F01180 FUSE, CARTRIDGE, 1/2 AMP 75915 313-500	16	30	70	136	38	35	34	1614	XX7	6-10	6		
X2	F								E	F01190 PANEL, FRONT 88183 A221-1-15	8									6-10	7		
P	F		5905-257-6569						E	F01200 RESISTOR, FIXED, COMPOSITION, 150K, 10 PCT, 1/2W 01121 EB1541	8	*	2	2	2	2	2	27	16	6-10	8		

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE										(1)		(2)		(3)						(4)		(5)		(6)		(7)						(8)		(9)		(10)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
SOURCE CD		MAINT. CD		REC. CODE		FEDERAL STOCK NUMBER		MODEL						IND. CD		DESCRIPTION						UNIT OF ISSUE		QTY INC IN UN PK		QTY INC IN UNIT		30 DAY MAINT. ALW.						PER 100 EQUIP. 1 YR. ALW.		DEPOT MAINT. ALW. PER 100 EQUIP.		ILLUSTRATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)	(AA)	(AB)	(AC)	(AD)	(AE)	(AF)	(AG)	(AH)	(AI)	(AJ)	(AK)	(AL)	(AM)	(AN)	(AO)	(AP)	(AQ)	(AR)	(AS)	(AT)	(AU)	(AV)	(AW)	(AX)	(AY)	(AZ)	(BA)	(BB)	(BC)	(BD)	(BE)	(BF)	(BG)	(BH)	(BI)	(BJ)	(BK)	(BL)	(BM)	(BN)	(BO)	(BP)	(BQ)	(BR)	(BS)	(BT)	(BU)	(BV)	(BW)	(BX)	(BY)	(BZ)	(CA)	(CB)	(CC)	(CD)	(CE)	(CF)	(CG)	(CH)	(CI)	(CJ)	(CK)	(CL)	(CM)	(CN)	(CO)	(CP)	(CQ)	(CR)	(CS)	(CT)	(CU)	(CV)	(CW)	(CX)	(CY)	(CZ)	(DA)	(DB)	(DC)	(DD)	(DE)	(DF)	(DG)	(DH)	(DI)	(DJ)	(DK)	(DL)	(DM)	(DN)	(DO)	(DP)	(DQ)	(DR)	(DS)	(DT)	(DU)	(DV)	(DW)	(DX)	(DY)	(DZ)	(EA)	(EB)	(EC)	(ED)	(EE)	(EF)	(EG)	(EH)	(EI)	(EJ)	(EK)	(EL)	(EM)	(EN)	(EO)	(EP)	(EQ)	(ER)	(ES)	(ET)	(EU)	(EV)	(EW)	(EX)	(EY)	(EZ)	(FA)	(FB)	(FC)	(FD)	(FE)	(FF)	(FG)	(FH)	(FI)	(FJ)	(FK)	(FL)	(FM)	(FN)	(FO)	(FP)	(FQ)	(FR)	(FS)	(FT)	(FU)	(FV)	(FW)	(FX)	(FY)	(FZ)	(GA)	(GB)	(GC)	(GD)	(GE)	(GF)	(GG)	(GH)	(GI)	(GJ)	(GK)	(GL)	(GM)	(GN)	(GO)	(GP)	(GQ)	(GR)	(GS)	(GT)	(GU)	(GV)	(GW)	(GX)	(GY)	(GZ)	(HA)	(HB)	(HC)	(HD)	(HE)	(HF)	(HG)	(HH)	(HI)	(HJ)	(HK)	(HL)	(HM)	(HN)	(HO)	(HP)	(HQ)	(HR)	(HS)	(HT)	(HU)	(HV)	(HW)	(HX)	(HY)	(HZ)	(IA)	(IB)	(IC)	(ID)	(IE)	(IF)	(IG)	(IH)	(II)	(IJ)	(IK)	(IL)	(IM)	(IN)	(IO)	(IP)	(IQ)	(IR)	(IS)	(IT)	(IU)	(IV)	(IW)	(IX)	(IY)	(IZ)	(JA)	(JB)	(JC)	(JD)	(JE)	(JF)	(JG)	(JH)	(JI)	(JJ)	(JK)	(JL)	(JM)	(JN)	(JO)	(JP)	(JQ)	(JR)	(JS)	(JT)	(JU)	(JV)	(JW)	(JX)	(JY)	(JZ)	(KA)	(KB)	(KC)	(KD)	(KE)	(KF)	(KG)	(KH)	(KI)	(KJ)	(KL)	(KM)	(KN)	(KO)	(KP)	(KQ)	(KR)	(KS)	(KT)	(KU)	(KV)	(KW)	(KX)	(KY)	(KZ)	(LA)	(LB)	(LC)	(LD)	(LE)	(LF)	(LG)	(LH)	(LI)	(LJ)	(LK)	(LM)	(LN)	(LO)	(LP)	(LQ)	(LR)	(LS)	(LT)	(LU)	(LV)	(LW)	(LX)	(LY)	(LZ)	(MA)	(MB)	(MC)	(MD)	(ME)	(MF)	(MG)	(MH)	(MI)	(MJ)	(MK)	(ML)	(MN)	(MO)	(MP)	(MQ)	(MR)	(MS)	(MT)	(MU)	(MV)	(MW)	(MX)	(MY)	(MZ)	(NA)	(NB)	(NC)	(ND)	(NE)	(NF)	(NG)	(NH)	(NI)	(NJ)	(NK)	(NL)	(NM)	(NN)	(NO)	(NP)	(NQ)	(NR)	(NS)	(NT)	(NU)	(NV)	(NW)	(NX)	(NY)	(NZ)	(OA)	(OB)	(OC)	(OD)	(OE)	(OF)	(OG)	(OH)	(OI)	(OJ)	(OK)	(OL)	(OM)	(ON)	(OO)	(OP)	(OQ)	(OR)	(OS)	(OT)	(OU)	(OV)	(OW)	(OX)	(OY)	(OZ)	(PA)	(PB)	(PC)	(PD)	(PE)	(PF)	(PG)	(PH)	(PI)	(PJ)	(PK)	(PL)	(PM)	(PN)	(PO)	(PP)	(PQ)	(PR)	(PS)	(PT)	(PU)	(PV)	(PW)	(PX)	(PY)	(PZ)	(QA)	(QB)	(QC)	(QD)	(QE)	(QF)	(QG)	(QH)	(QI)	(QJ)	(QK)	(QL)	(QM)	(QN)	(QO)	(QP)	(QQ)	(QR)	(QS)	(QT)	(QU)	(QV)	(QW)	(QX)	(QY)	(QZ)	(RA)	(RB)	(RC)	(RD)	(RE)	(RF)	(RG)	(RH)	(RI)	(RJ)	(RK)	(RL)	(RM)	(RN)	(RO)	(RP)	(RQ)	(RR)	(RS)	(RT)	(RU)	(RV)	(RW)	(RX)	(RY)	(RZ)	(SA)	(SB)	(SC)	(SD)	(SE)	(SF)	(SG)	(SH)	(SI)	(SJ)	(SK)	(SL)	(SM)	(SN)	(SO)	(SP)	(SQ)	(SR)	(SS)	(ST)	(SU)	(SV)	(SW)	(SX)	(SY)	(SZ)	(TA)	(TB)	(TC)	(TD)	(TE)	(TF)	(TG)	(TH)	(TI)	(TJ)	(TK)	(TL)	(TM)	(TN)	(TO)	(TP)	(TQ)	(TR)	(TS)	(TT)	(TU)	(TV)	(TW)	(TX)	(TY)	(TZ)	(UA)	(UB)	(UC)	(UD)	(UE)	(UF)	(UG)	(UH)	(UI)	(UJ)	(UK)	(UL)	(UM)	(UN)	(UO)	(UP)	(UQ)	(UR)	(US)	(UT)	(UU)	(UV)	(UW)	(UX)	(UY)	(UZ)	(VA)	(VB)	(VC)	(VD)	(VE)	(VF)	(VG)	(VH)	(VI)	(VJ)	(VK)	(VL)	(VM)	(VN)	(VO)	(VP)	(VQ)	(VR)	(VS)	(VT)	(VU)	(VV)	(VW)	(VX)	(VY)	(VZ)	(WA)	(WB)	(WC)	(WD)	(WE)	(WF)	(WG)	(WH)	(WI)	(WJ)	(WK)	(WL)	(WM)	(WN)	(WO)	(WP)	(WQ)	(WR)	(WS)	(WT)	(WU)	(WV)	(WW)	(WX)	(WY)	(WZ)	(XA)	(XB)	(XC)	(XD)	(XE)	(XF)	(XG)	(XH)	(XI)	(XJ)	(XK)	(XL)	(XM)	(XN)	(XO)	(XP)	(XQ)	(XR)	(XS)	(XT)	(XU)	(XV)	(XW)	(XZ)	(YA)	(YB)	(YC)	(YD)	(YE)	(YF)	(YG)	(YH)	(YI)	(YJ)	(YK)	(YL)	(YM)	(YN)	(YO)	(YP)	(YQ)	(YR)	(YS)	(YT)	(YU)	(YV)	(YW)	(YX)	(YZ)	(ZA)	(ZB)	(ZC)	(ZD)	(ZE)	(ZF)	(ZG)	(ZH)	(ZI)	(ZJ)	(ZK)	(ZL)	(ZM)	(ZN)	(ZO)	(ZP)	(ZQ)	(ZR)	(ZS)	(ZT)	(ZU)	(ZV)	(ZW)	(ZX)	(ZY)	(ZZ)
X2	F																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																						
(1) (A) SOURCE CD	(B) MAINT. CD	(C) REC. CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UNIT	(7) 30 DAY MAINT. ALW.						(8) 1 YR. ALW. PER 100 EQUIP.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION	
				MODEL									DS		GS		CS					
				1	2	3	4	5	6			(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)			
C	F										40											
P	F		5950-854-0494								16	2	3	5	2	2	2	46	32	6-10	16	
X2	F										96									6-10	17	
C	F										16											
C	F										96											
C	F										96											
P	F		5905-295-3913								16	*	2	2	2	2	2	27	16	6-10	18	
P	F		5820-810-8193								8	*	2	2	*	2	2	16	8	6-10	19	
C	F										48											

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																																
(1)	(A) SOURCE CD	(B)(C) MAINT. CD	(C) REC. CODE	(2) FEDERAL STOCK NUMBER						(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UNIT	(7) 30 DAY MAINT. ALW.						(8) 1 YR. ALW. PER 100 EQUIP. CNTGCTY PL.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION					
																											(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER				
				MODEL						IND. CD									DS						GS							
				1	2	3	4	5	6								(A)	(B)	(C)	(A)	(B)	(C)										
C	F									*																						
X2	F									D																						
C	F									D																						
P	F									D																						
C	F									*																						
C	F									*																						
C	F									*																						
A	H	R								D																						
P	F									E																						

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																							
(1)	(2)		(3)						(4)	(5)	(6)	(7)						(8)	(9)	(10)			
	(A)	(B)	(C)	FEDERAL STOCK NUMBER	DESCRIPTION							30 DAY MAINT. ALW.								(A)	(B)		
					1	2	3	4				5	6	DS	GS								
P	F			5935-257-9940																			
A	F	R																					
X2	F																						
C	F																						
C	F																						
C	F																						
P	F			5935-577-0009																			

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT,
AND DEPOT MAINTENANCE[illegible]

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																								
(1)	(A)	(B)(C)	(2)		(3)							(4)	(5)	(6)	(7)						(8)	(9)	(10)	
SOURCE CD	MAINT. CD	REC. CODE	FEDERAL STOCK NUMBER	DESCRIPTION	MODEL							UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UNIT	30 DAY MAINT. ALW.						PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	FIGURE NUMBER	ITEM OR SYMBOL NUMBER
					1	2	3	4	5	6				(A)	(B)	(C)	(A)	(B)	(C)			(A)	(B)	
X2	F		5815-788-5180	F01650 GUIDE, MIDDLE 88183 8239-1-12							D												6-10	32
X2	F		5815-788-5182	F01660 GUIDE, LARGE 88183 85-0663							D												6-10	33
C	F			F01670 SCREW, SELF-LOCKING, BIND. HD, SLOT., BRS, NI PL, 6-32 BY 5/16 IN. LG 88183 COML							*													
C	F			F01680 SCREW, SELF-LOCKING, BIND. HD, SLOT., BRS, NI PL, 4-40 BY 3/8 IN. LG 88183 COML							*													
X2	F		5805-788-5181	F01690 BAR, FASTENER 88183 C239-1-13							D												6-10	34
C	F			F01700 SCREW, MACHINE, FH, BRS, NI PL, 4-40 BY 1/4 IN. LG 88183 COML							*													
X2	F			F01710 SHELF 88183 D239-1-10							D												6-10	35
C	F			F01720 SCREW, SELF-LOCKING, BIND. HD, SLOT., BRS, NI PL, 6-32 BY 3/8 IN. LG 88183 COML							*													
X2	F			F01730 FRAME 88183 D239-1-11							D												6-10	36

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE											
(1)		(2)		(3)		(4)					
SOURCE CD	(A)	(B)	(C)	FEDERAL STOCK NUMBER	DESCRIPTION	UNIT OF ISSUE					
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REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE													(10) ILLUSTRATION											
(1) (A) SOURCE CD		(B)(C) MAINT. CD		(2) FEDERAL STOCK NUMBER		(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UNIT	(7) 30 DAY MAINT. ALW.						(8) 1 YR. ALW. PER 100 EQUIP. CNTRY PL.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION (A) FIGURE NUMBER (B) ITEM OR SYMBOL NUMBER	
																						(A)	(B)	

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																										
(1)	(A)	(B)(C)	(2)	(3)						(4)	(5)	(6)	(7)						(8)	(9)	(10)					
SOURCE CD			FEDERAL STOCK NUMBER	MODEL						DESCRIPTION	UNIT OF ISSUE	QTY INC IN UN PK	QTY INC IN UNIT	30 DAY MAINT. ALW.						1 YR. ALW. PER 100 EQUIP.	DEPOT MAINT. ALW. PER 100 EQUIP.	FIGURE NUMBER	ITEM OR SYMBOL NUMBER			
MAINT. CD				1	2	3	4	5	6					DS		GS		51-100								
K2	F									C	F02000 RACK,ELECTRICAL EQUIPMENT MT-3326/MRC-85(V)2 88183 7-0345														6-12	5
A	F	R								C	F02010 PANEL, PROTECTION, ELECTRICAL SYSTEM SB-2328/MRC-85(V)2 SEE FIG 6 NHA SAME AS F01960	REF													6-13	
A	F	R								D	F02020 CONTROL SUBASSEMBLY,LOOP CURRENT 88183 D252-2-11	1													6-13	
C	F									*	F02030 SCREW,MACHINE, BIND. HD,BRS,6-32 BY 3/4 IN. LG 88183 COML	2														
C	F									*	F02040 SCREW,MACHINE, BIND. HD,BRS,6-32 BY 1/4 IN. LG 88183 COML	7														
C	F									*	F02050 WASHER, LOCK, BRS, 6-32 88183 COML	9														
C	F									*	F02060 NUT,PLAIN,HEX., BRS,6-32 THD 99141 COML	9														
P	O		5920-812-3654							E	F02070 FUSE,CARTRIDGE, 1/8 AMP,250V 75915 312-125	48	93	225	440	116	115	110	5210	XX7					6-13	1

REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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(1)	(A) SOURCE CD		(B) MAINT. CD	(C) REC. CODE	(2) FEDERAL STOCK NUMBER						(3) DESCRIPTION						(4) UNIT OF ISSUE	(5) QTY INC IN UN PK	(6) QTY INC IN UNIT	(7) 30 DAY MAINT. ALW.						(8) PER 100 EQUIP. 1 YR. ALW. CNTGY PL.	(9) DEPOT MAINT. ALW. PER 100 EQUIP.	(10) ILLUSTRATION	
																												(A) FIGURE NUMBER	(B) ITEM OR SYMBOL NUMBER
					MODEL						IND CD									DS		GS							
					1	2	3	4	5	6							(A)	(B)	(C)	(A)	(B)	(C)							
P	F				5905-193-2140						E F02170 RESISTOR, VARIABLE, 2500 OHMS, 25W SAME AS F02090								REF								6-13	7	
X2	F										E F02180 PLATE, MOUNTING 88183 D252-2-10-1								1								6-13	8	
P	F				5940-636-6464						D F02190 TERMINAL BOARD 75382 600-3-4ST-12								3								6-13	9	
C	F										* F02200 SCREW, MACHINE, BIND. HD, BRS, 6-32 BY 3/4 IN. LG 88183 COML								30										
C	F										* F02210 WASHER, LOCK, BRS, 6-32 88183 COML								30										
C	F										* F02220 NUT, PLAIN, HEX., BRS, 6-32 THD 88183 COML								30										
P	F				5905-283-4681						D F02230 RESISTOR, FIXED, WIREWOUND, 200 OHMS, 10W 63743 10F-200								48								6-13	10	
C	F										* F02240 SCREW, MACHINE, RH, BRS, 6-32 BY 2-1/4 IN. LG 88183 COML								48										
C	F										* F02250 WASHER, FLAT, BRS, 6-32 88183 COML								48										

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C	F										*	F02260 WASHER, NONMETALLIC 88183 COML			96																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				</

SECTION V. FEDERAL STOCK NUMBER CROSS REFERENCE INDEX

FEDERAL STOCK NO.	FIG NO.	INDEX NO.	FEDERAL STOCK NO.	FIG NO.	INDEX NO.
5340-193-3644	6-10	29			
5805-788-5181	6-10	34			
5820-787-3486	6-10	31			
5820-810-8193	6-10	19			
5905-193-2140	6-13	3			
5905-193-2140	6-13	7			
5905-257-6569	6-10	8			
5905-279-2656	6-9	22			
5905-283-4681	6-13	10			
5905-295-3913	6-10	18			
5905-755-5140	6-9	21			
5905-812-1679	6-9	24			
5905-825-1184	6-9	19			
5905-839-1658	6-9	20			
5920-199-9498	6-10	6			
5920-577-2264	6-10	5			
5920-577-2264	6-13	6			
5920-577-2264	6-13	2			
5920-812-3654	6-13	5			
5920-812-3654	6-13	1			
5930-286-2598	6-10	2			
5930-655-4508	6-11	9			
5935-129-9358	6-11	4			
5935-192-4812	6-9	12			
5935-201-3181	6-9	2			
5935-201-3181	6-9	4			
5935-221-6510	6-10	24			
5935-257-8546	6-11	22			
5935-257-9940	6-11	25			
5935-577-0008	6-12	7			
5935-577-0009	6-11	28			
5935-577-2336	6-12	5			
5935-835-4290	6-12	11			
5935-848-6626	6-9	6			
5935-848-6626	6-9	8			
5935-947-1145	6-9	13			
5940-201-7368	6-10	11			
5940-549-7530	6-9	18			
5940-636-6464	6-13	9			
5945-629-8862	6-11	3			
5950-854-0494	6-13	16			
6240-223-9100	6-10	4			
6250-683-0320	6-10	3			

(Prefix each Reference Number with the Chapter Number denoted by the Column.)
 (KEY: Numbers preceded by "f" are illustrations; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 5		Chapter 6 Circuit Diagrams
				Org/Field Maintenance	Align- ment	
CONTROL, POWER SUPPLY C-6369/MRC-85(V)2 Power Supply Panel	28, 32, 33, f10, t1	7, f3, t3	50, f4	21, f4		6
CONVERTER, FREQUENCY SHIFT CV-1201/GGA-10, CV-1206/GGA-10 through CV-1212/GGA-10, and CV-1461/GGA-10 through CV-1464/ GGA-10 Tone Converter	28, 40, f9, t1, t2, t4	21, 28, 29, f1, t7	6, 11, 29, f1, f3	9, 20	40	3
KEYER, FREQUENCY SHIFT KY-390/GGA-10 through KY-401/GGA-10 Tone Keyer	28, 40, 42, 51, f9, t1, t2, t4	22, 24, 27, f1, t7	6, 8, 17, f1, f2	9, 33	36, 38, f7	
Line Battery Supply POWER SUPPLY PP-4167/MRC-85(V)2	31, f3, t1	50, 55, f1, f4	f4			
Loop Current Control Panel PANEL, PROTECTION, ELECTRICAL SYSTEM SB-2328/MRC-85(V)2	f3, f7, f10, t1	f4, t4	12, 43, f1		43	f2
PANEL, INDICATOR SB-2323/MRC-85(V)2 Volume and Current Level Indicator	f3, f9, t1	f5, t5	6, 16, 74, f1, f6		29	
PANEL, PATCHING, COMMUNICA- TION, SB-2322/MRC-85(V)2 Patch Panel	f9, t1	16, 18, 23, 30, f6, t6	6, 65, f1	23		5
PANEL, PROTECTION, ELECTRICAL SYSTEM SB-2328/MRC-85(V)2 Loop Current Control Panel	f3, f7, f10, t1	f4, t4	12, 43, f1		43	f2

CROSS-REFERENCE INDEX (Cont)

(Prefix each Reference Number with the Chapter Number denoted by the Column.)
(KEY: Numbers preceded by "f" are illustrations; "t" are tables; others are paragraphs.)

OFFICIAL NOMENCLATURE Common Name	Chapter 2 Installation	Chapter 3 Operation	Chapter 4 Principles of Operation	Chapter 5		Chapter 6 Circuit Diagrams
				Org/Field Maintenance	Align- ment	
Patch Panel	f9, t1	16, 18, 23, 30, f6, t6	6, 65, f1	23		5
PANEL, PATCHING, COMMUNICA- TION SB-2322/MRC-85(V)2						
POWER SUPPLY PP-2807/GGA-10	30, f3, t1	t7	58, f1, f5		31, f6	
Transistor Power Supply						
POWER SUPPLY PP-4167/MRC-85(V)2	31, f3, t1		50, 55, f1 f4	f4		
Line Battery Supply						
Power Supply Panel	28, 32, 33, f10, t1	7, f3, t3	50, f4	21, f4		6
CONTROL, POWER SUPPLY C-6369/MRC-85(V)2						
Tone Converter	28, 40, f9, t1, t2, t4	21, 28, 29, f1, t7	6, 11, 29, f1, f3	9, 20	40	3
CONVERTER, FREQUENCY SHIFT CV-1201/GGA-10, CV-1206/GGA-10 through CV-1212/GGA-10, and CV-1461/GGA-10 through CV-1464/ GGA-10						
Tone Keyer						
KEYER, FREQUENCY SHIFT KY-390/GGA-10 through KY-401/GGA-10	28, 40, 42, 51, f9, t1, t2, t4	22, 24, 27, f1, t7	6, 8, 17, f1, f2	9, 33	36, 38, f7	
Transistor Power Supply	30, f3, t1	t7	58, f1, f5		31, f6	
POWER SUPPLY PP-2807/GGA-10						
Volume and Current Level Indicator PANEL, INDICATOR SB-2323/MRC-85(V)2	f3, f9, t1	f5, t5	6, 16, 74, f1, f6		29	

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By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

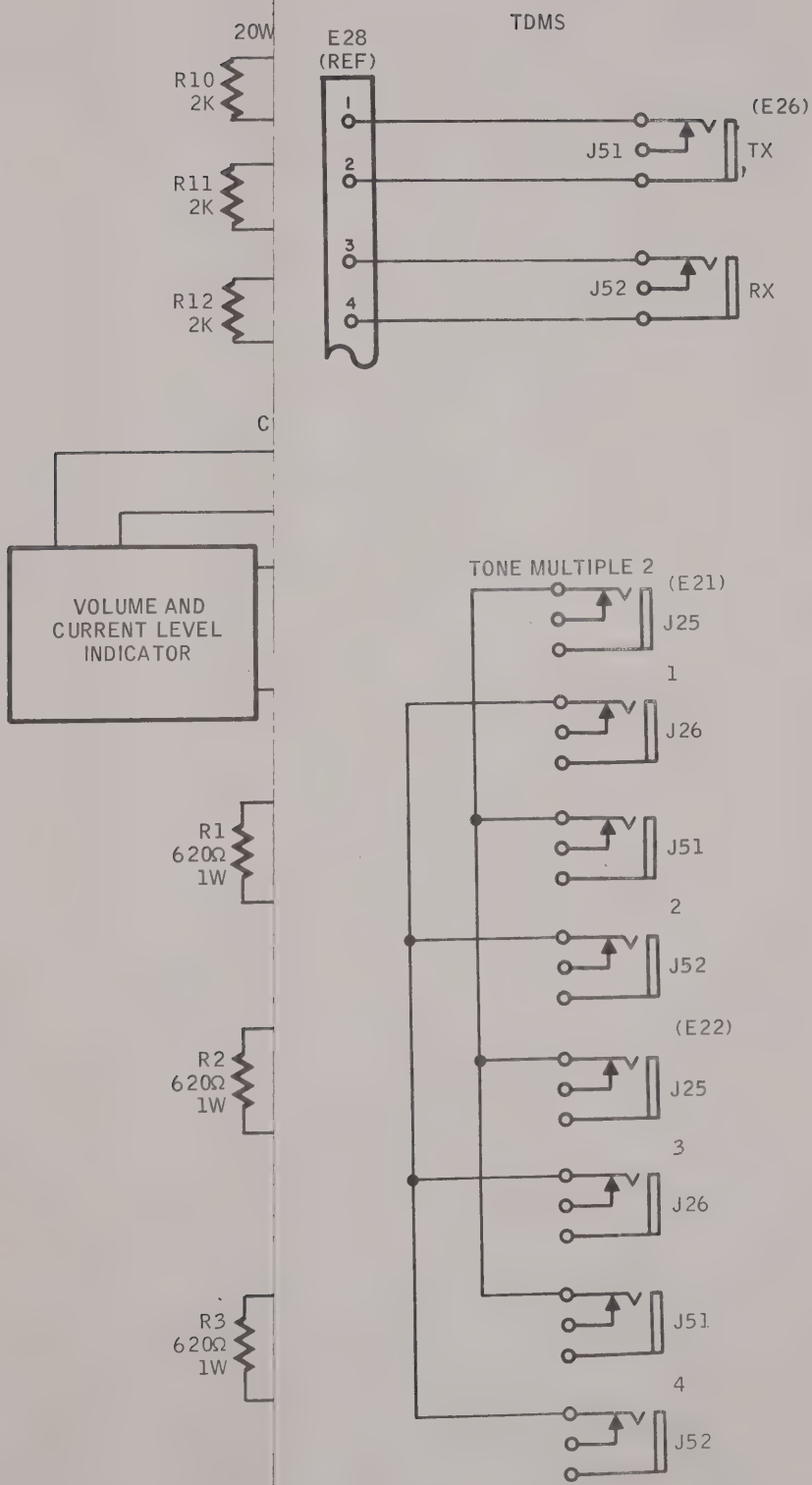
USAMB (5)
USACDCEC (5)
Eighth USA (5)
1st LOGCOMD (5)
2nd LOGCOMD (5)
9th LOGCOMD (5)

USACDCCEA Ft Huachuca (1)
SAAD (5)
TOAD (5)
LEAD (3)
USASTRATCOM (3)
USASTRATCOM-PAC (5)

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.



atch Panel, Schematic Diagram

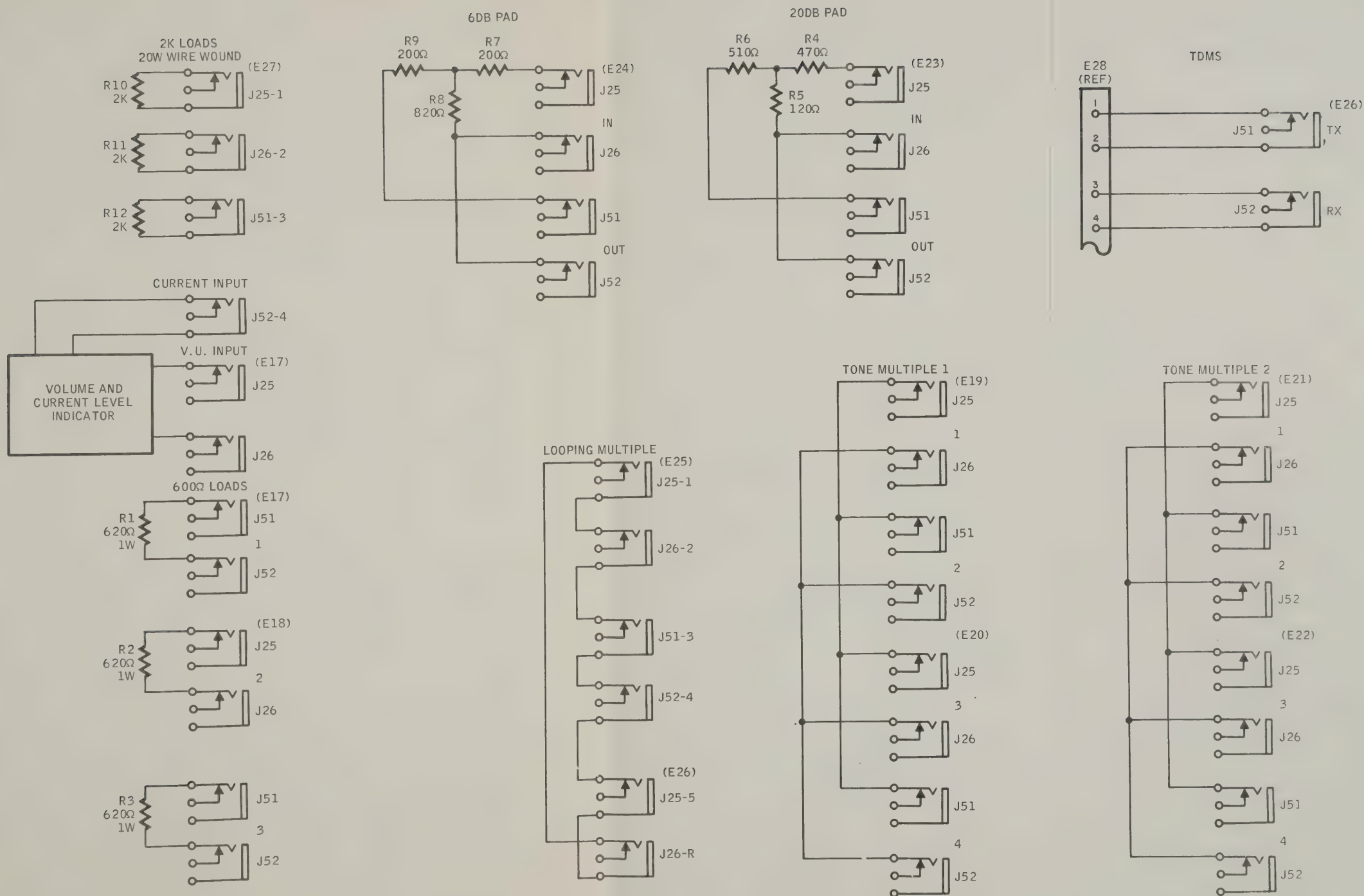
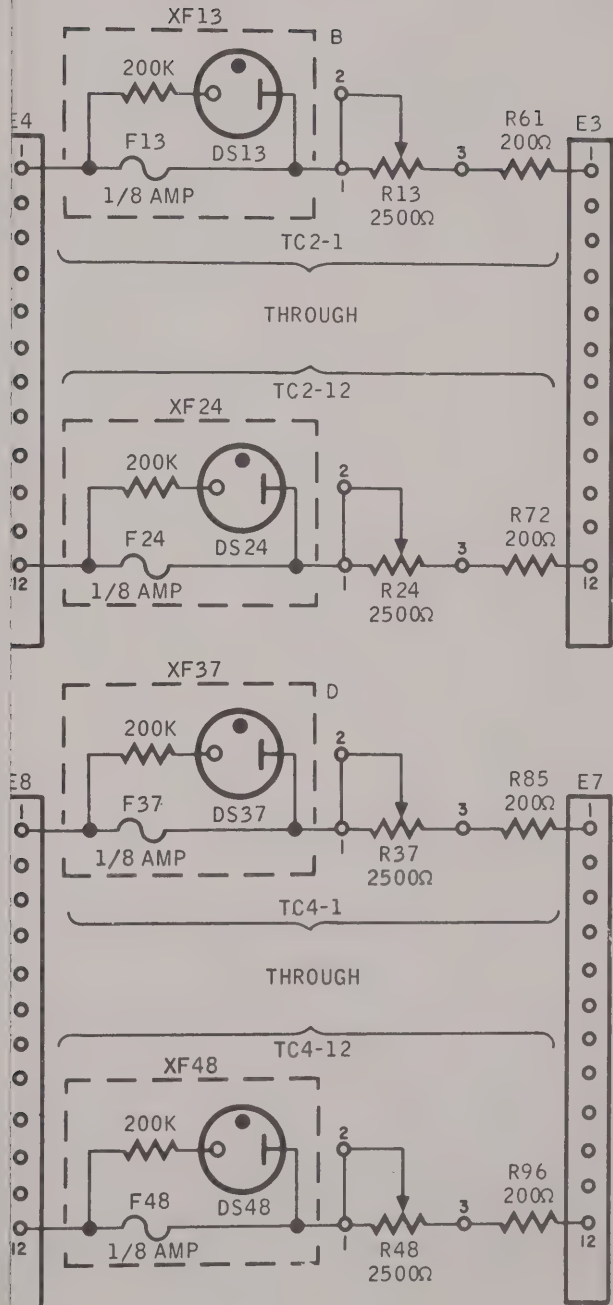
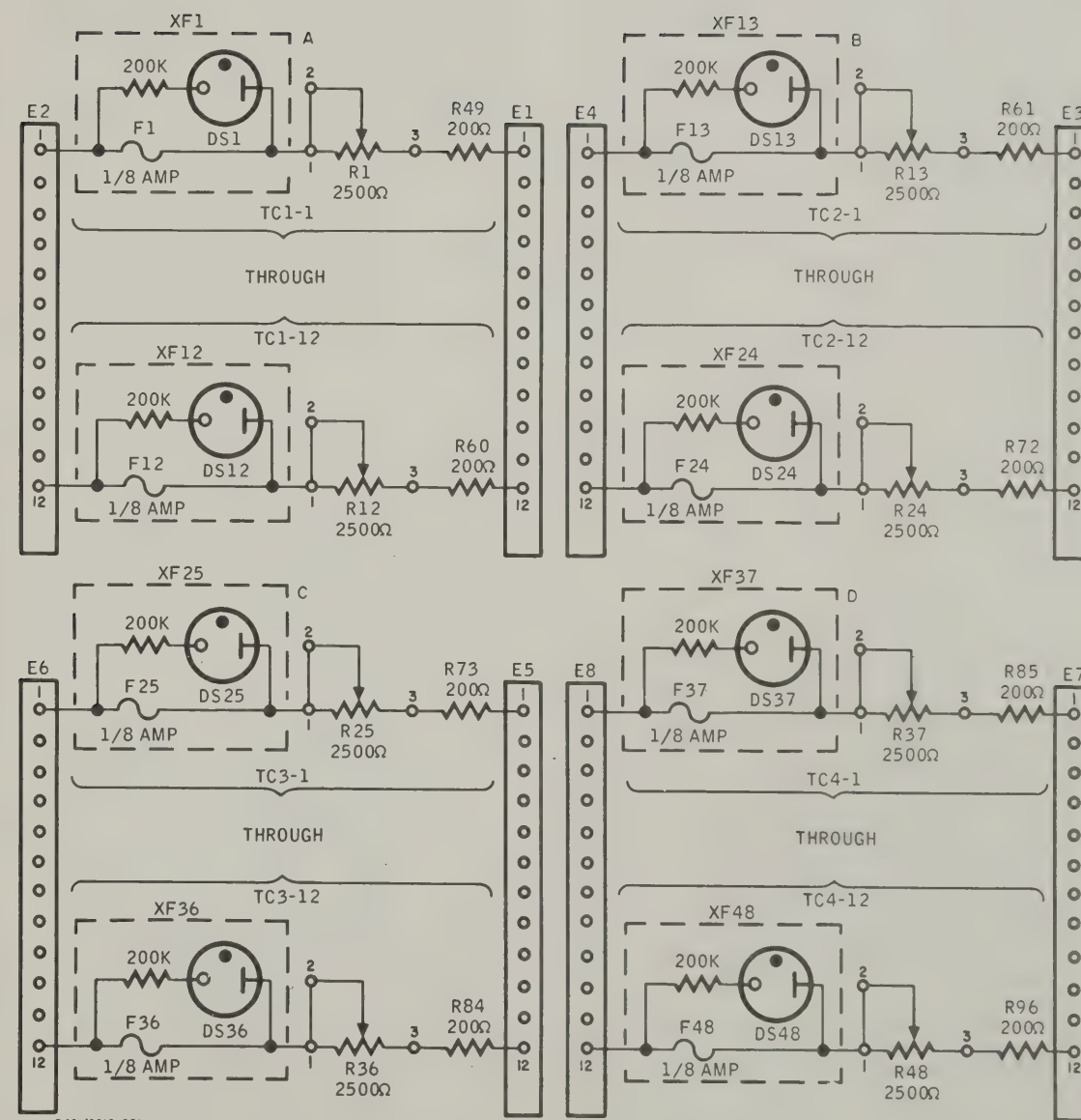


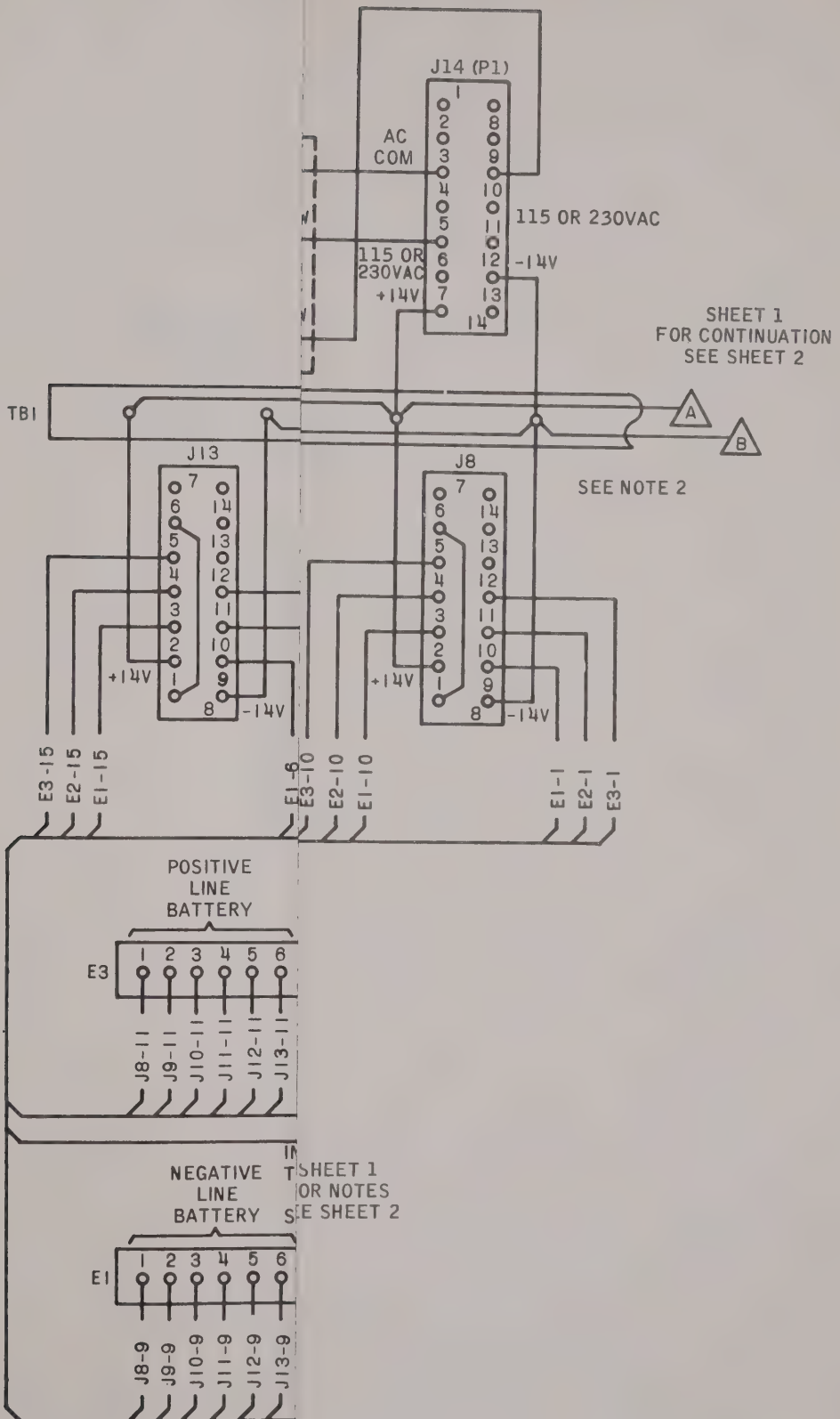
Figure 6-1. Auxiliary Patch Panel, Schematic Diagram





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Figure 6-2. Loop Current Control Panel, Schematic Diagram



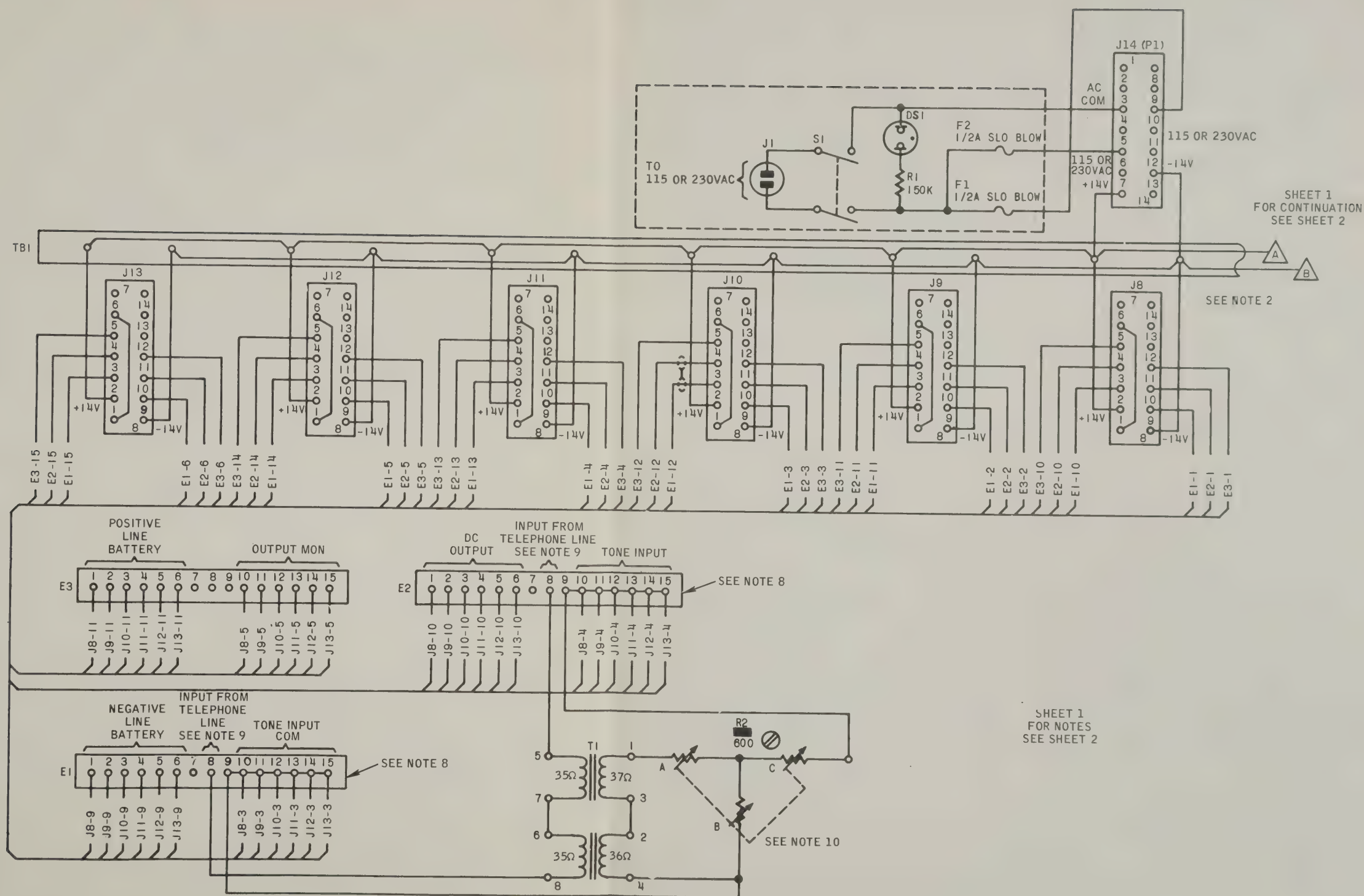


Figure 6-3. Tone Keyer and Converters Equipment Shelf, Schematic Diagram (Sheet 1 of 2)

INSTALLATION OF MULTIPLEXER GROUP, CONNECT
THE COMPOSITE TONE INPUT LINE TO TERMINALS
E6-8 AND E2-8 OF UNIT 1A2 ONLY. CONNECT THE
COMPOSITE TONE OUTPUT LINE TO TERMINALS E4-8
AND E5-8 OF UNIT 1A2 ONLY
MULTIPLEXER GROUP, LEVELS OF SYSTEM
COMPOSITE INPUT AND OUTPUT TONES ARE
ADJUSTED WITH ATTENUATORS R2 AND R3,
RESPECTIVELY, OF FREQUENCY-SHIFT KEYER
AND CONVERTER SHELF 1A2

SHEET 2
FOR CONTINUATION
SEE SHEET 1

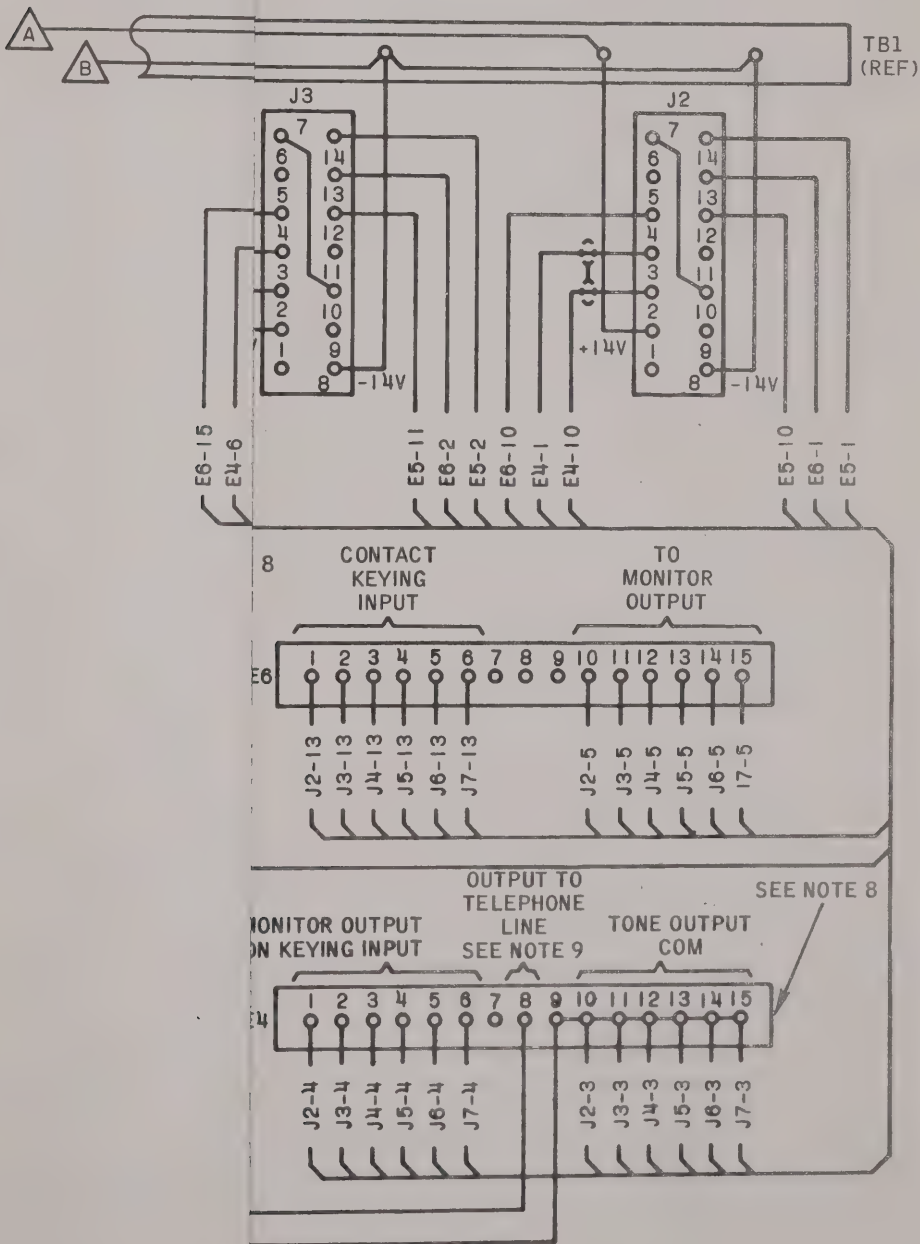


Figure 6-3. Tone K

NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX DESIGNATIONS WITH 1A3 THROUGH 1A10

2. J2 THROUGH J7 TO TONE KEYS. J8 THROUGH J13 TO TONE CONVERTERS

3. TERMINAL STRIPS E1, E2 AND E3 PROVIDE COMPOSITE TONE INPUT AND DC OUTPUT TERMINATIONS FOR TONE CONVERTERS. TERMINAL STRIPS E4, E5 AND E6 PROVIDE DC INPUT AND COMPOSITE TONE OUTPUT TERMINATIONS FOR TONE KEYS

4. VALUES IN OHMS UNLESS OTHERWISE NOTED

5. THE REFERENCE SYMBOL NUMBERS SHOWN IN PARENTHESIS INDICATE THE ASSOCIATED MATING CONNECTOR

6. CONNECT COMPOSITE TONE INPUT TO TERMINALS E1-8 AND E2-8, USING SHIELDED CABLE
7. CONNECT SHIELDED CABLE TO TERMINALS E4-8 AND E5-8 FOR COMPOSITE TONE OUTPUT

8. IN INSTALLATION OF MULTIPLEXER GROUP, MAKE THE FOLLOWING INTERCONNECTIONS BETWEEN THE FREQUENCY-SHIFT KEYS AND CONVERTER SHELVES

A. 1A2E1-9 TO 1A3E1-9

B. 1A3E1-9 TO 1A4E1-9

C. 1A2E2-9 TO 1A3E2-9

D. 1A3E2-9 TO 1A4E2-9

E. 1A2E4-9 TO 1A3E4-9

F. 1A3E4-9 TO 1A4E4-9

G. 1A2E5-9 TO 1A3E5-9

H. 1A3E5-9 TO 1A4E5-9
9. IN INSTALLATION OF MULTIPLEXER GROUP, CONNECT THE COMPOSITE TONE INPUT LINE TO TERMINALS E1-8 AND E2-8 OF UNIT 1A2 ONLY. CONNECT THE COMPOSITE TONE OUTPUT LINE TO TERMINALS E4-8 AND E5-8 OF UNIT 1A2 ONLY

10. IN MULTIPLEXER GROUP, LEVELS OF SYSTEM COMPOSITE INPUT AND OUTPUT TONES ARE ADJUSTED WITH ATTENUATORS R2 AND R3, RESPECTIVELY, OF FREQUENCY-SHIFT KEYS AND CONVERTER SHELF 1A2

SHEET 2
FOR CONTINUATION
SEE SHEET 1

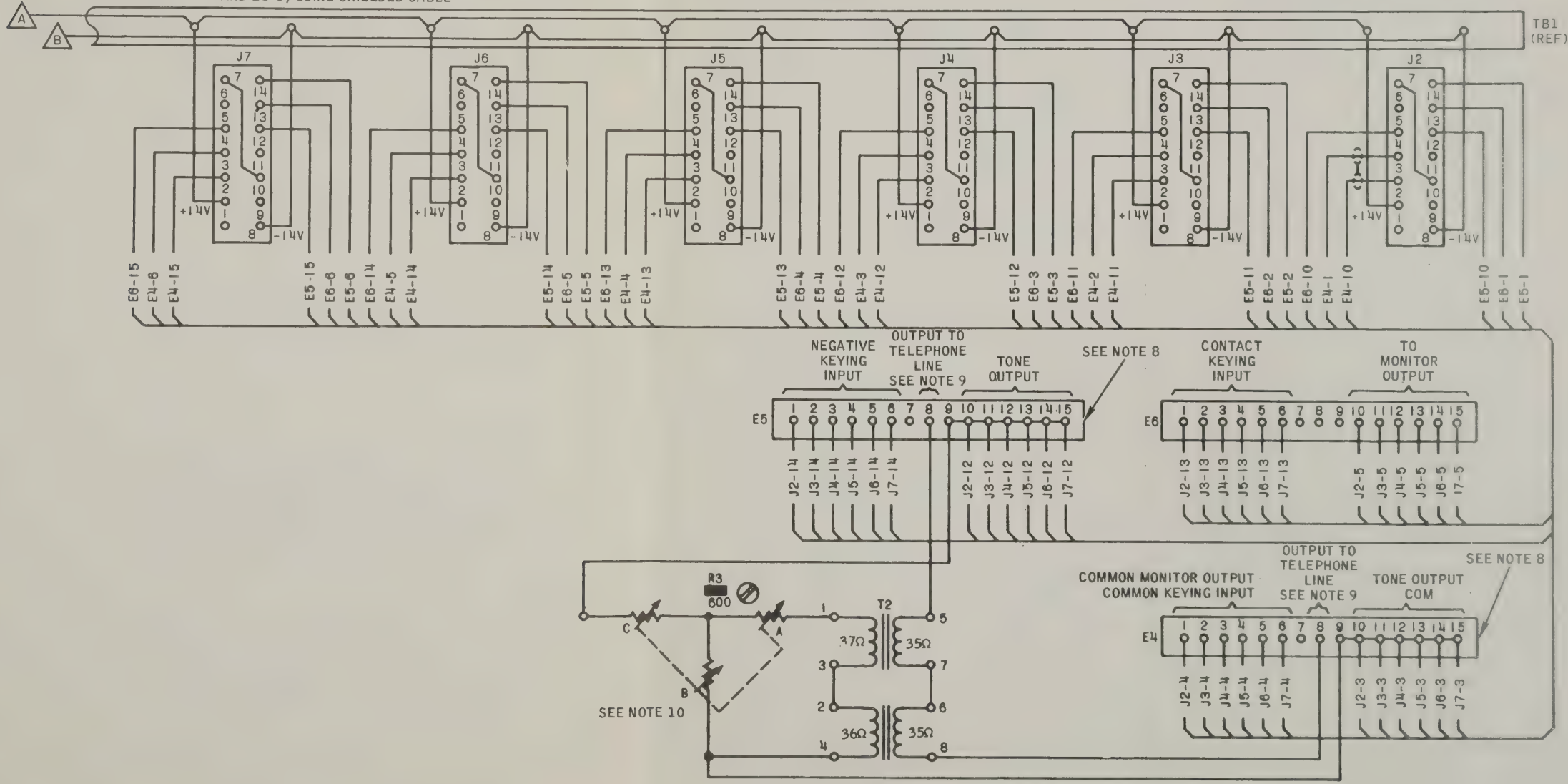
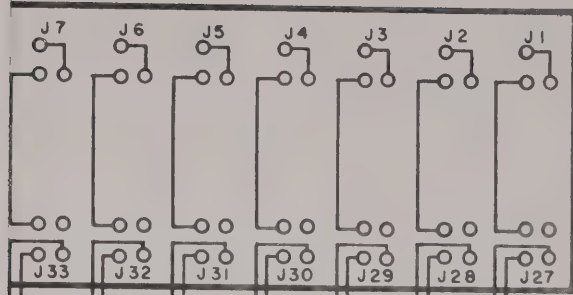
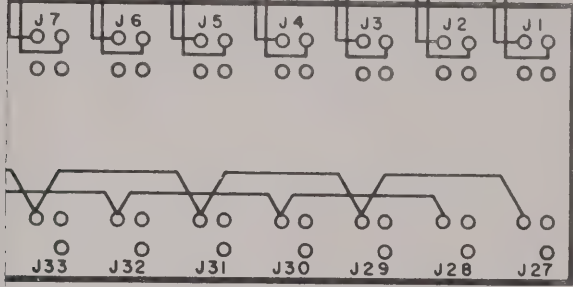


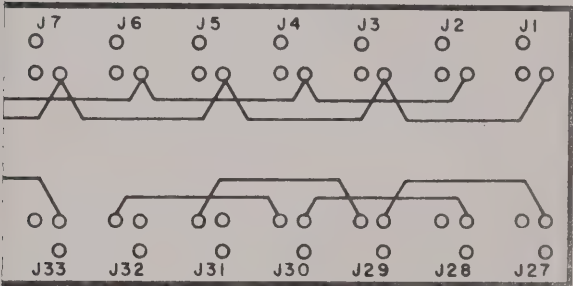
Figure 6-3. Tone Keyer and Converters Equipment Shelf, Schematic Diagram (Sheet 2 of 2)



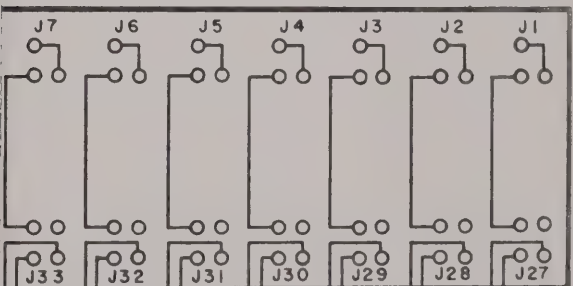
E 17



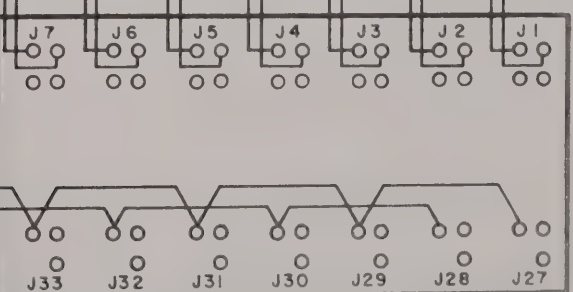
E 18



E 19



E 20



E 21

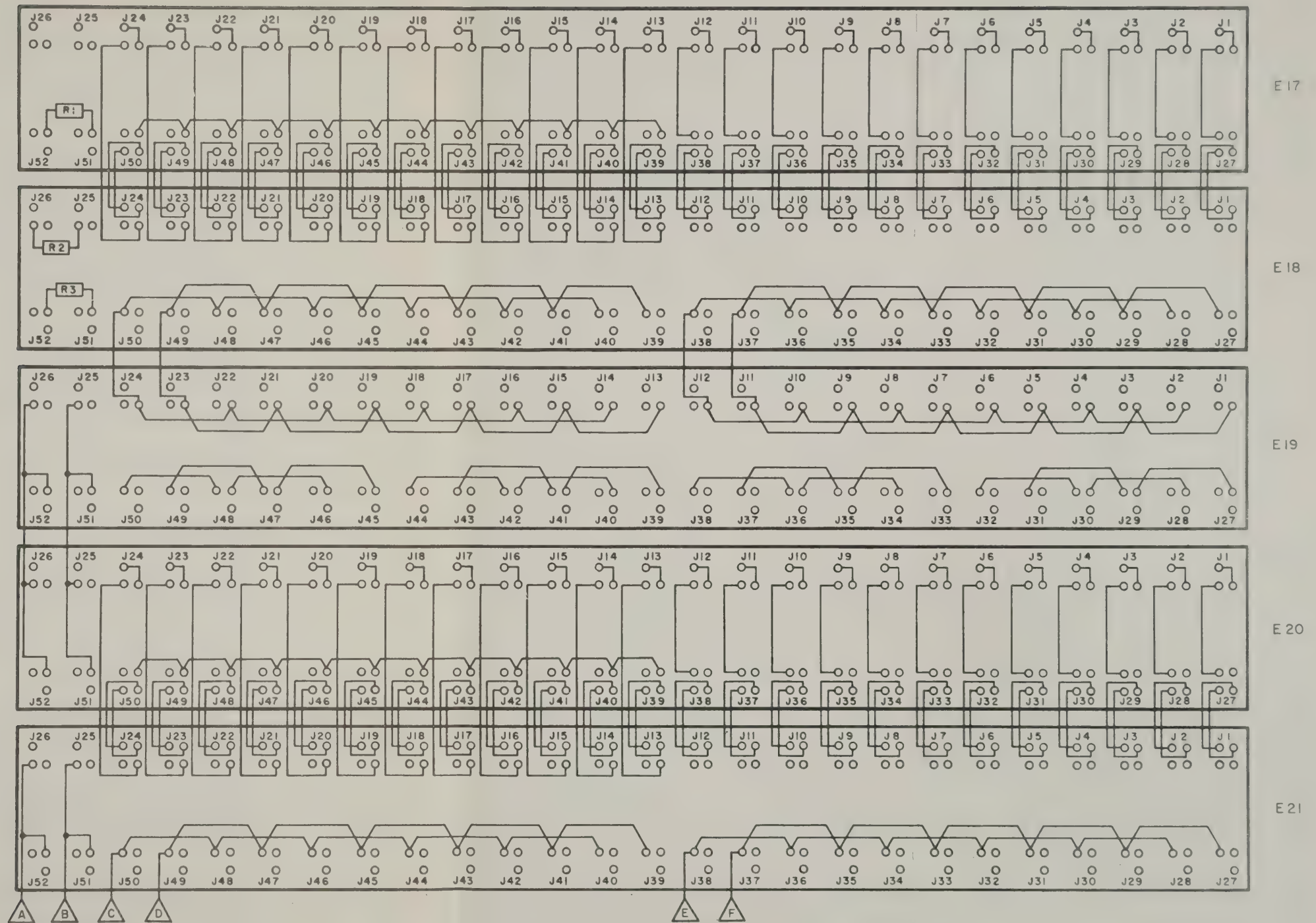
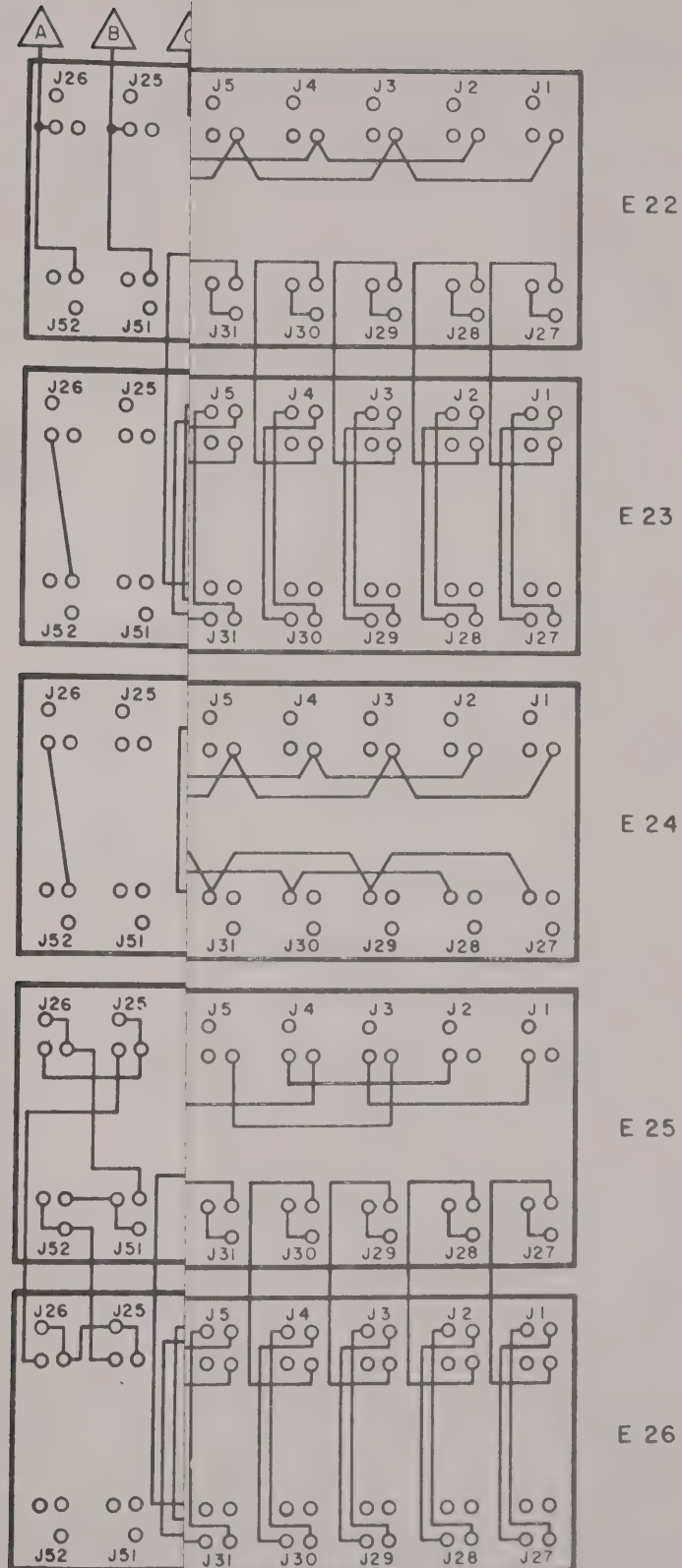


Figure 6-5. Patch Panel, Schematic Diagram (Sheet 1 of 3)



Schematic Diagram (Sheet 2 of 3)

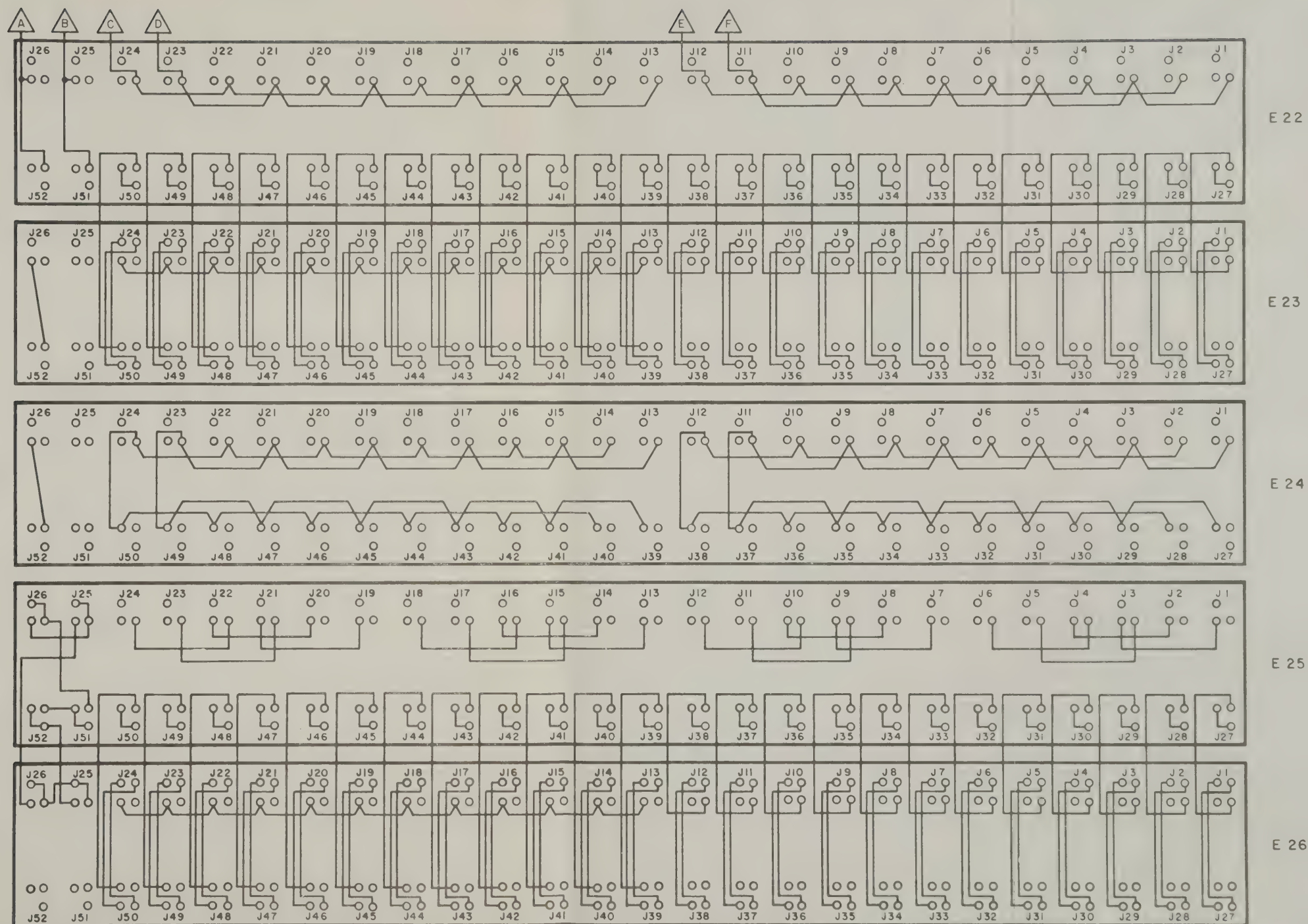
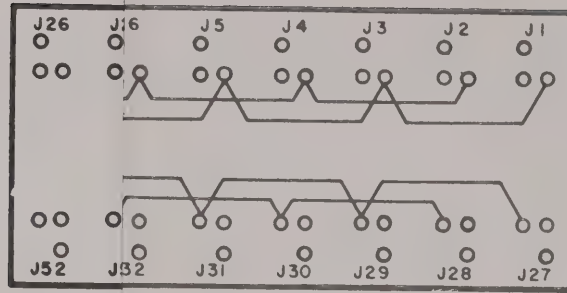


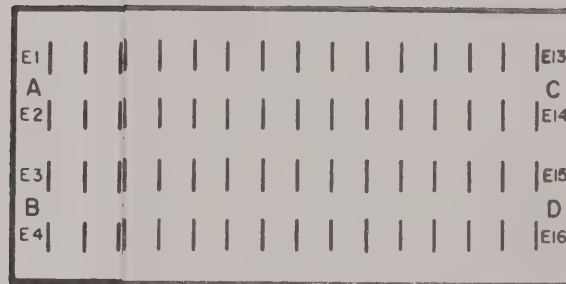
Figure 6-5. Patch Panel, Schematic Diagram (Sheet 2 of 3)



E 27

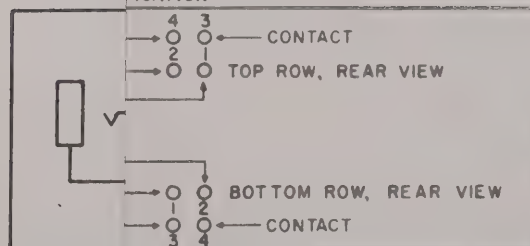
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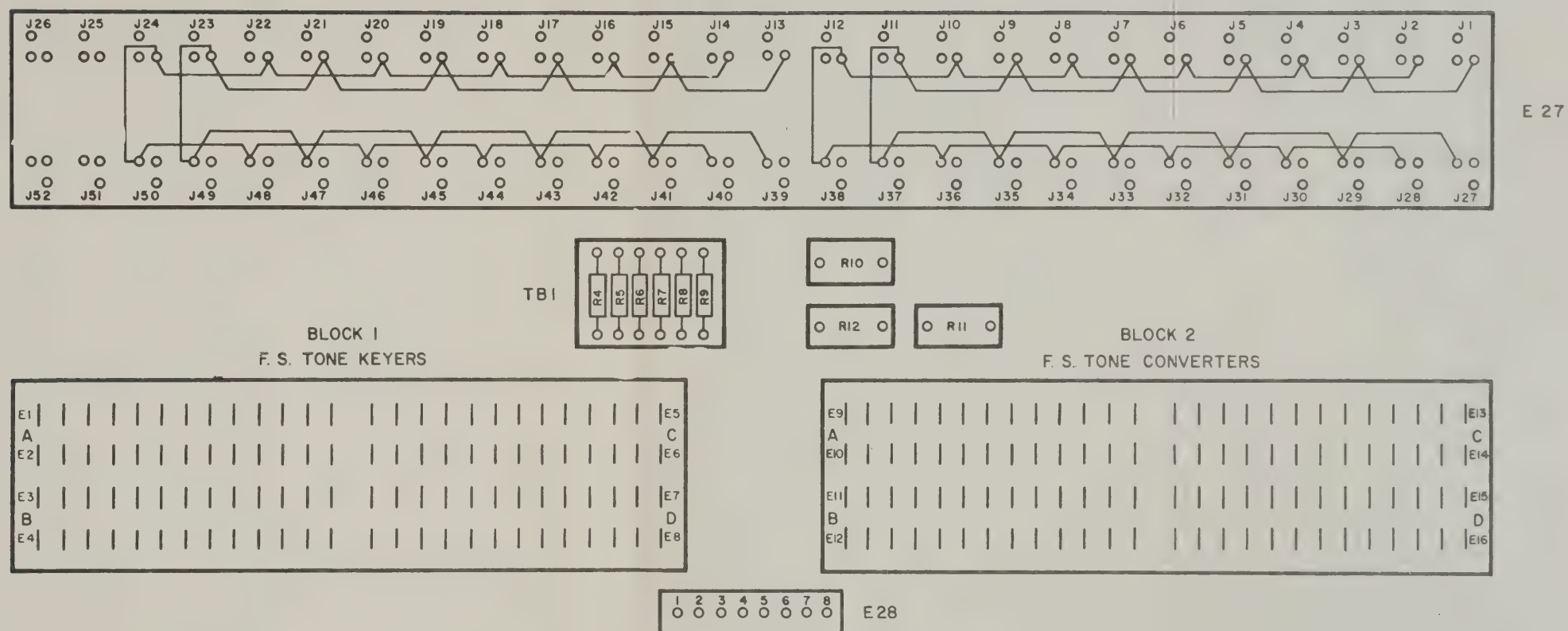


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SHEET 3
FOR CONTINUATION
SEE SHEETS 1 AND 2

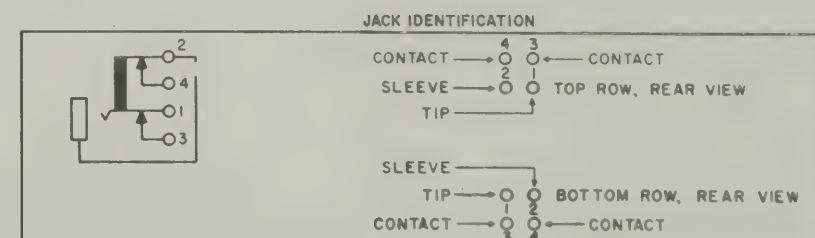
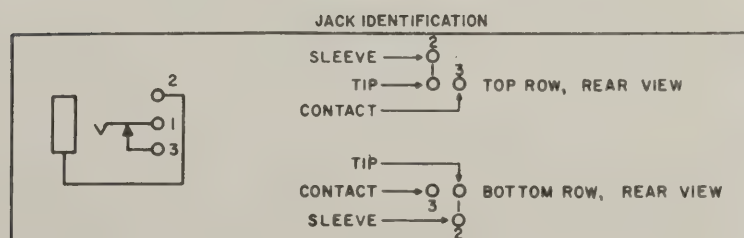


Figure 6-5. Patch Panel, Schematic Diagram (Sheet 3 of 3)

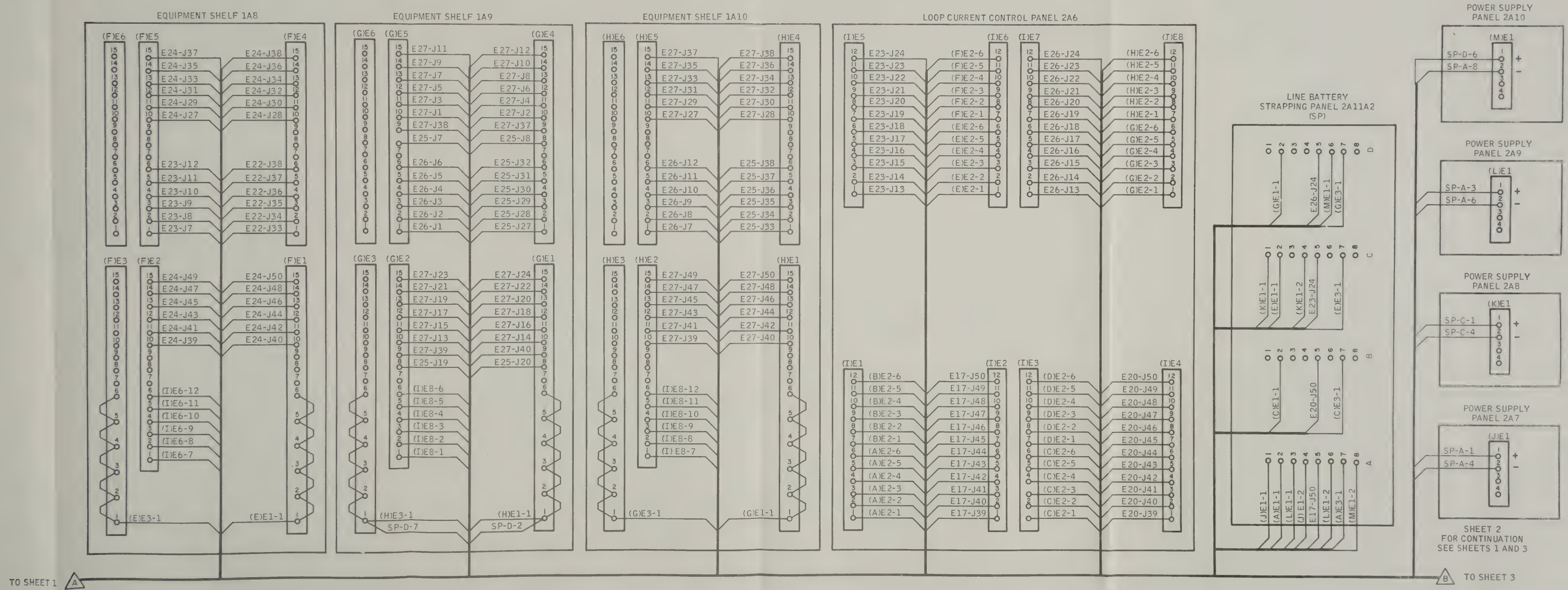
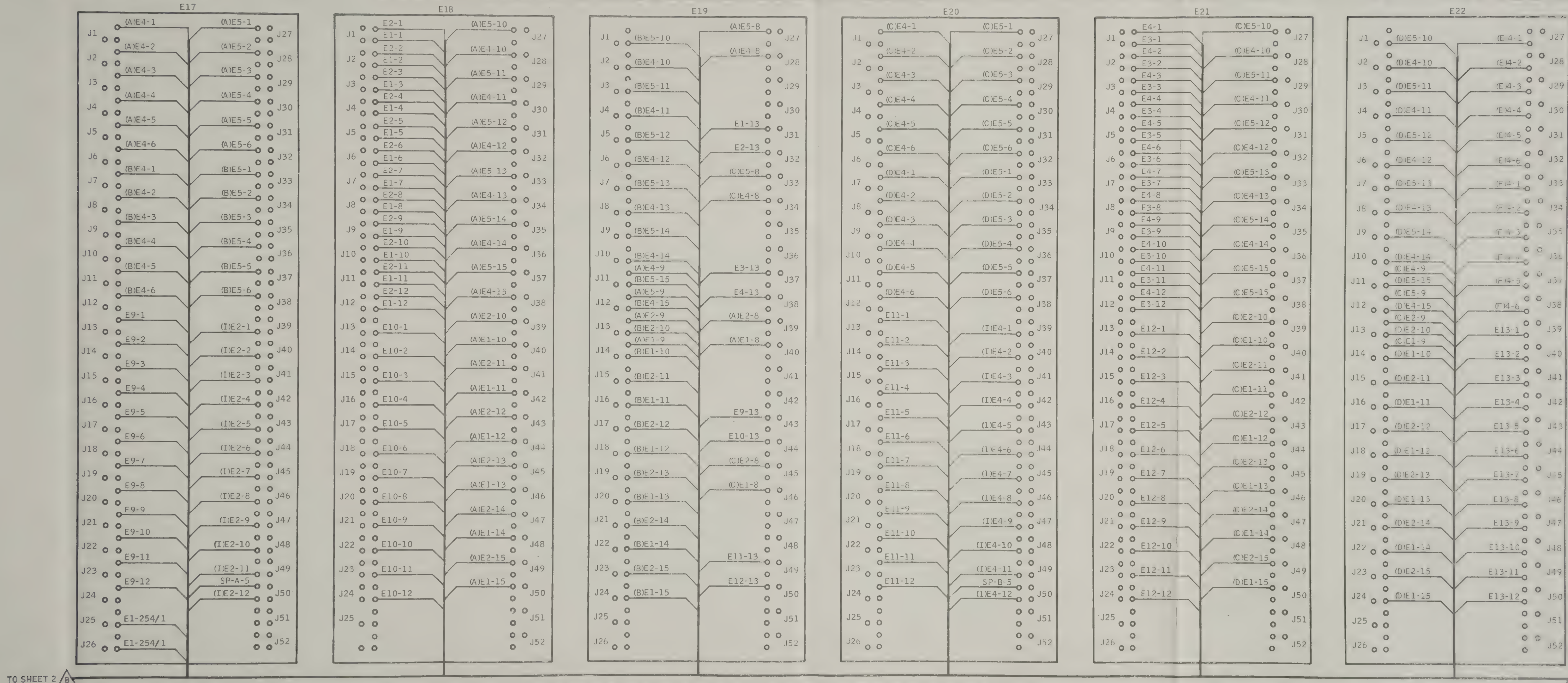


Figure 6-6. Systems Interconnecting Cable (Sheet 2 of 5)

DETAIL NO. 1 (R/LF)



SHEET 3
FOR CONTINUATION
SEE SHEETS 2 & 4

Figure 6-6. Systems Interconnecting Cable (Sheet 3 of 5)

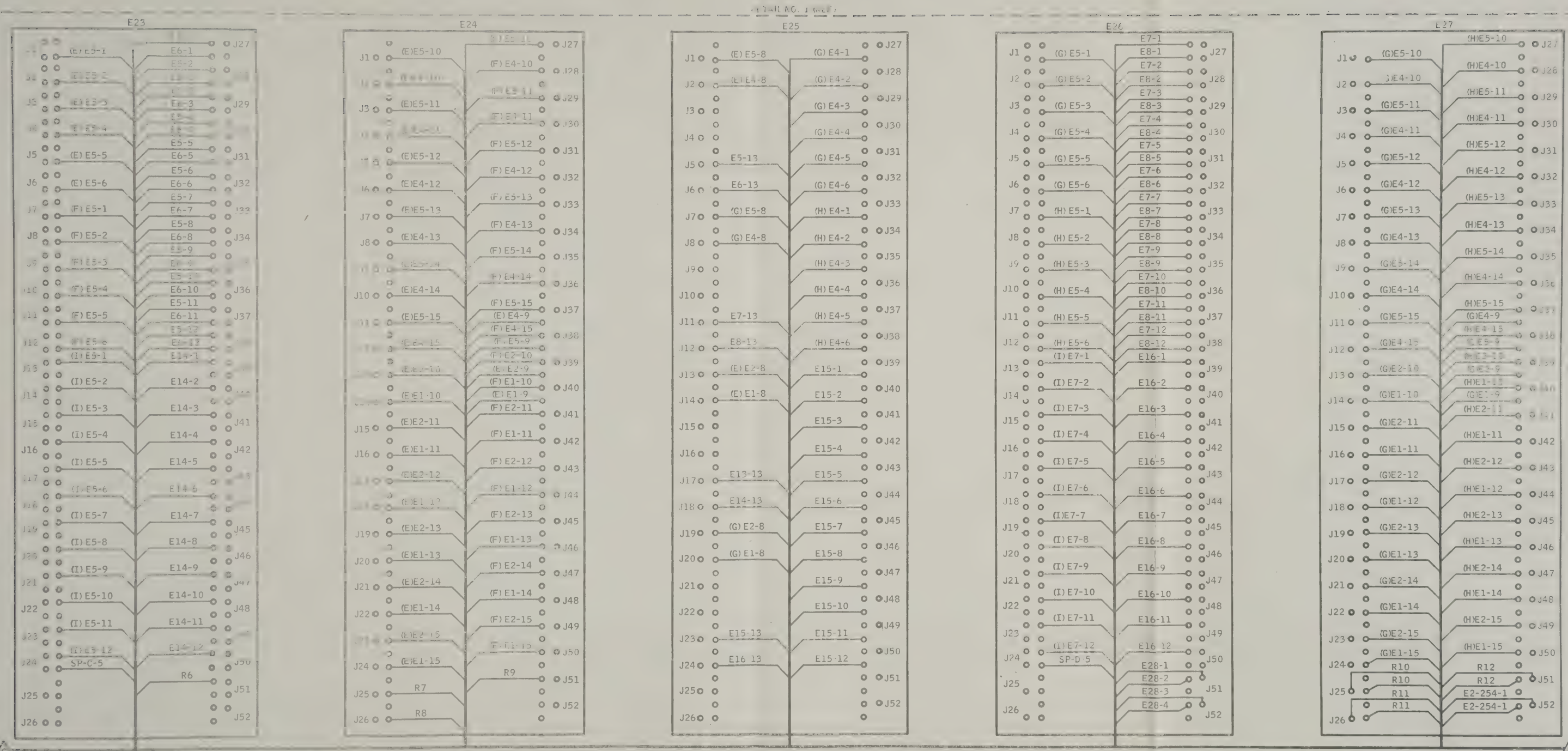
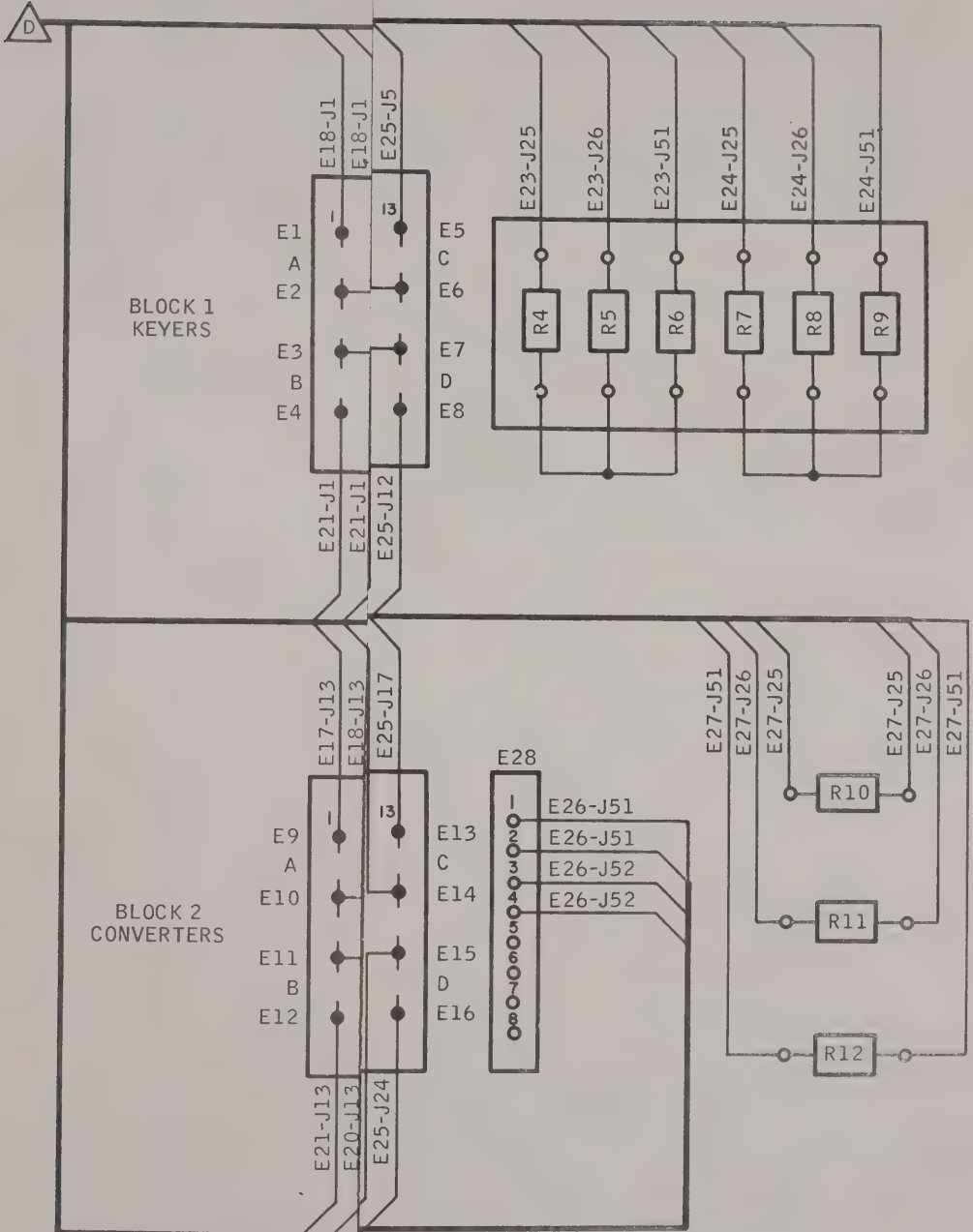


Figure 6-6. Systems Interconnecting Cable (Sheet 4 of 5)

SHEET 5
FOR CONTINUATION
SEE SHEET 4



SHEET 5
FOR CONTINUATION
SEE SHEET 4

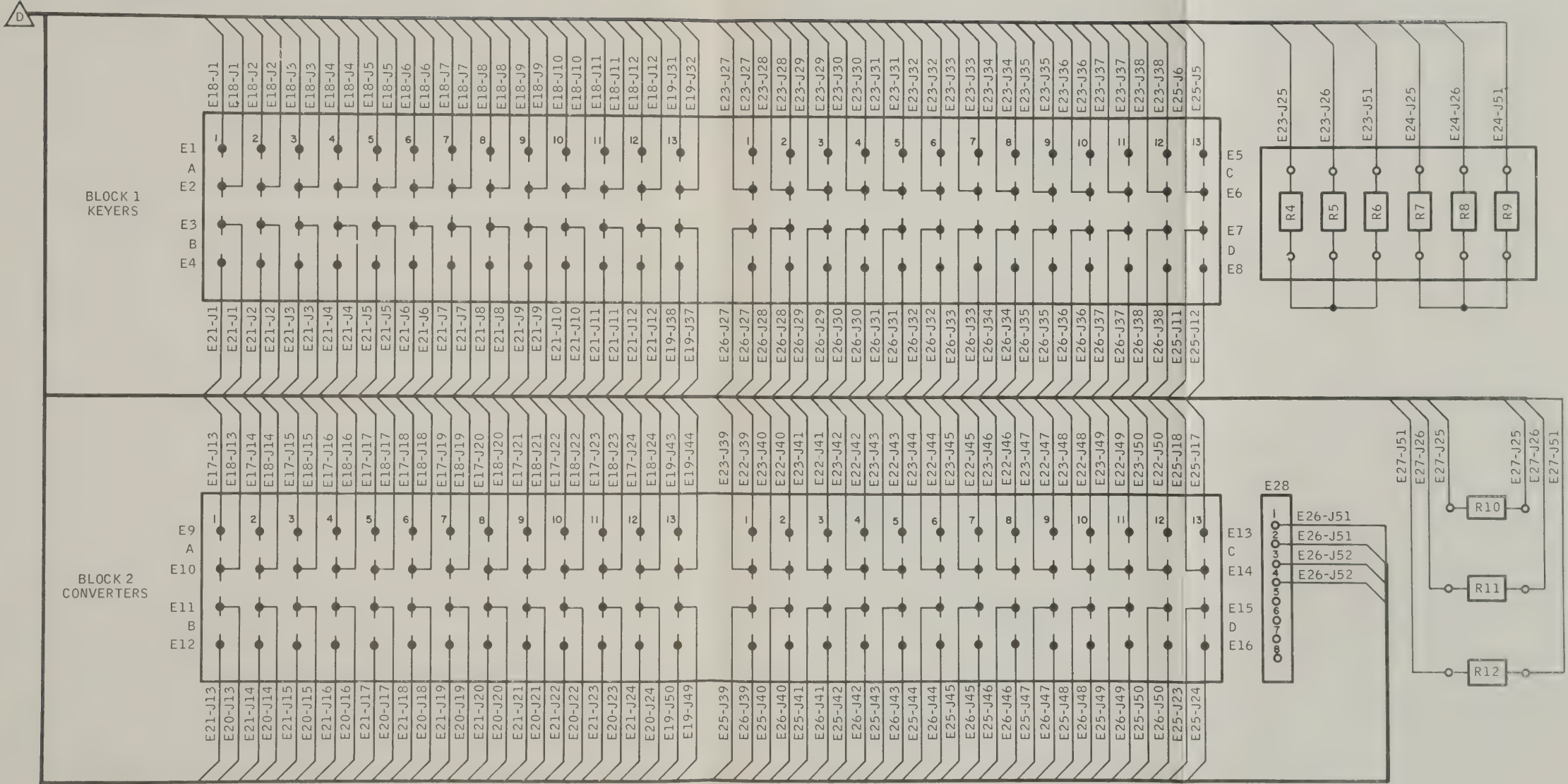


Figure 6-6. Systems Interconnecting Cable (Sheet 5 of 5)

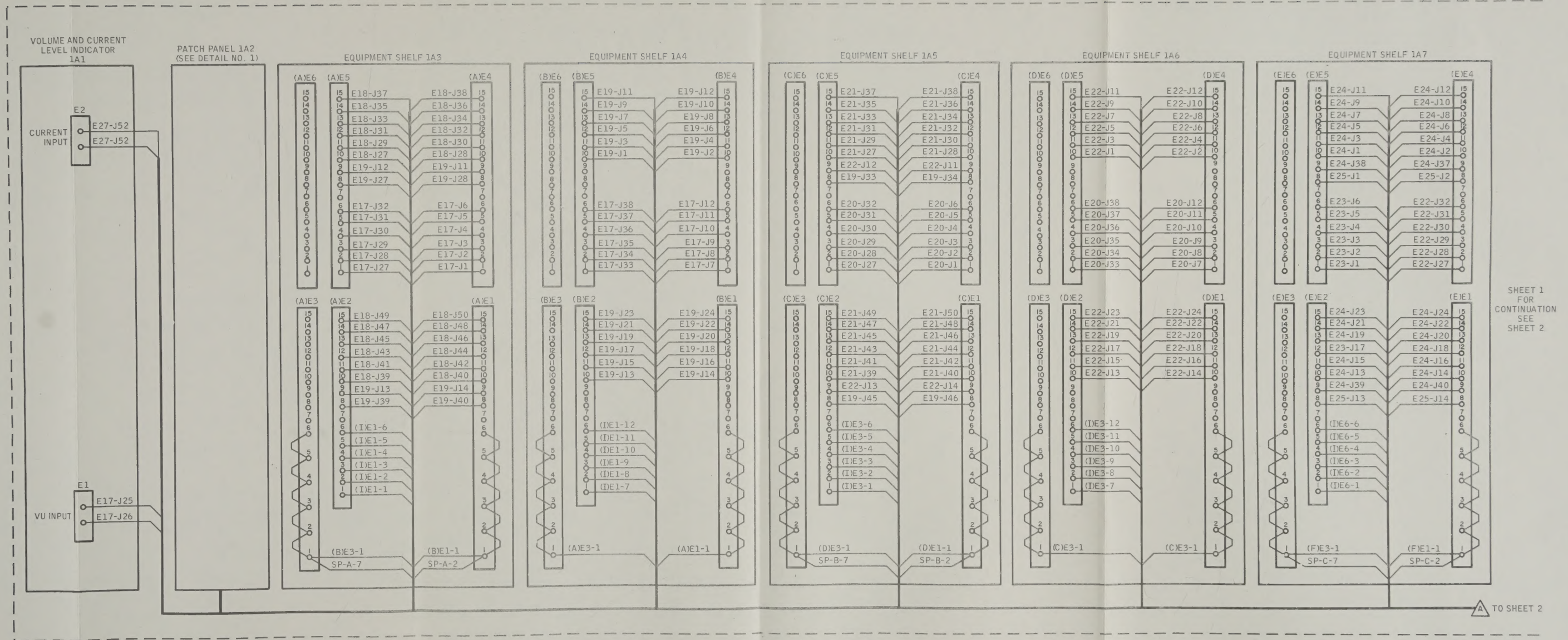


Figure 6-6. Systems Interconnecting Cable (Sheet 1 of 5)

